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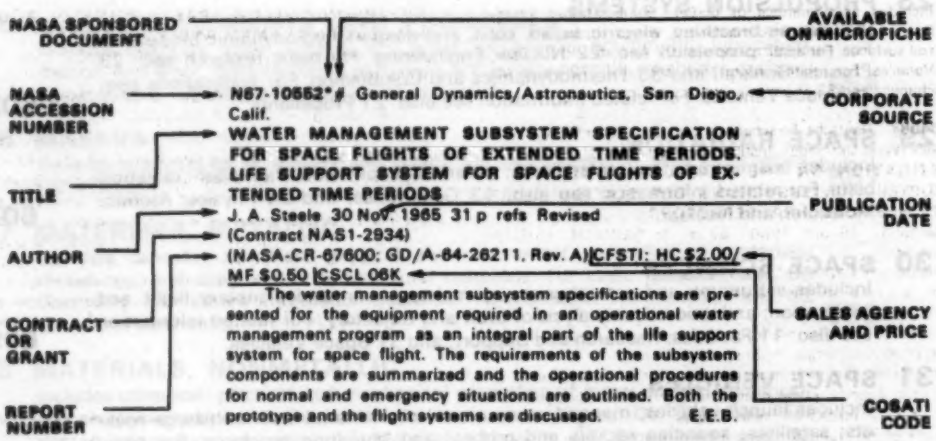
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N67-10852* # General Dynamics/Astronautics, San Diego, Calif.
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TITLE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
PUBLICATION DATE
J. A. Steele 30 Nov. 1965 31 p refs Revised
AUTHOR
(Contract NAS1-2934)
CONTRACT OR GRANT
(NASA-CR-67600; GD/A-64-26211, Rev. A)
CFSTI: HC $2.00/ MF $0.50 CSCL 06K
SALES AGENCY AND PRICE
REPORT NUMBER
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed.
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VOLUME 5 NUMBER 4

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February 23, 1967

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N67-13458# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugmechanik.

INVESTIGATION ON THE BLADE DEFLECTION OF A HELICOPTER [UNTERSUCHUNG DER BLATTDURCHBIEGUNG EINES HUBSCHRAUBERROTORS]

M. Marchand 25 Jul. 1966 57 p In GERMAN; ENGLISH summary

(DLR-FB-66-55) CFSTI: HC $3.00/MF $0.50

The analysis of the blade deflection cinematographically measured at the front rotor of a tandem helicopter (Vertol H-21, V-44) is described. The blade tip deflection is investigated as a function of azimuth angle, flight speed and weight to be carried by the rotor. From the deflections measured, the curvatures of the blade in the flapping plane caused by bending are determined at five points. By means of these values, data are given on the magnitude of the static and dynamic stress of the blade as well as on the effect of flight speed, azimuth angle, and weight to be carried by the rotor on these stresses. Author

N67-13641# Max-Planck-Institut fur Stromungsforschung, Gottingen (West Germany).

ON THE FRICTIONLESS HYPERSONIC FLOW WITH DETACHED COMPRESSION SHOCK WAVE AROUND AN EVEN PROFILE WITH SHARP LEADING EDGE [UEBER DIE REIBUNGSFREIE HYPERSCHALLSTROEMUNG MIT ABGELOESTEM VERDICHTUNGSSTOSS UM EBENE PROFILE MIT SCHARFER VORDERKANTE]

G. Grabitz 1965 76 p refs In GERMAN

(Rept.-34) CFSTI: HC $3.00/MF $0.50

Investigated were flow fields with detached compression shock in front of thick profiles with a thin leading edge. Practical calculation methods were developed for two problems of this type. The detached compression shock in front of symmetrical circular-arc profiles caused by hypersonic flow was numerically calculated by the approximation method. It was found that a small subsonic zone develops if the angle of the detached shock is slight. The curvature of such profiles was therefore approximated in the subsonic range, which resulted in an analytical approximate solution for the flow field at flow velocity $M_\infty \to \infty$. Transl. by K.W.

N67-13718# Tokyo Univ. (Japan) Inst. of Space and Aeronautical Science.

SUPERSONIC FLOW PAST POINTED BODIES OF REVOLUTION AT SMALL ANGLES OF ATTACK

Kenjiro Iwasaki and Keiichi Karashima (Hitachi, Ltd.) Aug. 1966 27 p refs

(ISAS-405, Vol. 31, No. 6) CFSTI: HC $2.00/MF $0.50

A general method of theoretical approach to supersonic flow past lifting bodies of revolution with arbitrary geometry is presented assuming that the flow behind an attached shock wave consists of a basic non-lifting field upon which is superimposed a perturbation field due to small angles of attack is particularly applied to circular cones as a simple example. It is shown that, although the nonlinearity in fundamental equations predicting the basic field has a predominant effect on aerodynamic characteristics of the body, a linear approximation of perturbation field with respect to angle of attack still seems to be available even if the body is not so slender. Experimental results also confirm this. Author

N67-13768# Aerodynamische Versuchsanstalt, Gottingen (West Germany).

THE FLOW ON AEROFOIL PROFILES WITH BLOWING OUT FROM A NOSE SLOT [DIE STROMUNG AN FLUGELPROFILEN MIT AUSBLASEN AUS EINEM NASENSPALT]

W. Wuest Aug. 1966 44 p refs In GERMAN; ENGLISH summary

(DLR-FB-66-57; AVA-FB-6607) CFSTI: HC $2.00/MF $0.50

On two symmetric airfoil models with nose slot, pressure, temperature, and velocity distributions with blowing out of cold or hot air have been measured in a boundary layer wind tunnel. Both models had the same constant pressure nose profile, but one airfoil was unswept and the other had a sweep angle of 65°. The measurements were extended to incidence angles of −10°, 0°, and 10°, and free stream velocities from 12 to 40 m/s, the rate of blowing out being constant. Author

N67-13792*# National Aeronautics and Space Administration, Washington, D. C.

CALCULATION OF AERODYNAMIC CHARACTERISTICS OF WING AND FUSELAGE IN SUPERSONIC FLOW [CALCUL DES CARACTERISTIQUES AERODYNAMIQUES D'UN ENSEMBLE AILE-FUSELAGE EN ECOULEMENT SUPERSONIQUE]

M. Enselme Nov. 1966 14 p refs Transl. into ENGLISH from French Paper No. 66-22 presented at 5th Congr. of the Intern. Council of the Aeron. Sci., London, 12–16 Sep. 1966
(NASA-TT-F-10430) CFSTI: HC $1.00/MF $0.50 CSCL 01A

The supersonic aerodynamics problem of wing–fuselage interaction, solved with the lifting surface theory, is reviewed, and the proposed analog method is described. A two-dimensional network of inductances and capacitances represents partial derivatives where the analog of time is identified with the spatial variable taken along the velocity, with the aerodynamic boundary conditions transformed into the electric conditions imposed at the network boundaries. For developing a computation method and for checking its velocity, a comparison between analog computer and wind tunnel is given for a delta wing aircraft at various Mach numbers. The results of the study are presented. Author

N67-13796*# National Aeronautics and Space Administration, Washington, D. C.
STABILITY RESEARCH ON PARACHUTES USING DIGITAL AND ANALOG COMPUTERS [STABILITAETSUNTERSUCHUNGEN AN FALLSCHIRMEN MIT HILFE EINES DIGITAL- UND ANALOGRECHNERS]
R. Ludwig Nov. 1966 20 p refs Transl. into ENGLISH from German Presented at Intern. Symp. on Analog and Digital Tech. applied to Aeron., Liege, 9–12 Sep. 1963
(NASA-TT-F-10391) CFSTI: HC $1.00/MF $0.50 CSCL 01A

The nonlinear oscillation characteristics of a personnel guide surface parachute were calculated. The influence of the shroud line length, the entrained air mass variation, and the surrounding air density were investigated, along with the stable state of oscillation near zero angle of attack. The equations of motion are considered, and the solutions obtained using both digital and analog computers are discussed. N.E.N.

N67-13818# College of Aeronautics, Cranfield (England).
STUDIES IN STABILITY AND CONTROL ANALYSIS OF AIRFRAMES HAVING NONLINEAR AERODYNAMIC CHARACTERISTICS
P. A. T. Christopher Jun. 1966 29 p refs Presented at AGARD Flight Mech. Panel Specialists' Meeting, Cambridge, England, Sep. 1966
(COA-AERO-171) CFSTI: HC $2.00/MF $0.50

The problem of longitudinal stability and control of an airframe, having nonlinearity in its principal aerodynamic characteristics, is considered. It is shown that the equation describing the response in w, and thus the incidence, is a nonlinear differential equation of the fourth order. This equation, and its degenerate forms, is used as an example to demonstrate various nonlinear techniques and their shortcomings. Author

N67-13847 Technische Hochschule Munchen (West Germany). Institut fuer Stroemungsmechanik.
AERODYNAMIC COEFFICIENTS OF WINGS AND FUSELAGES IN RAREFIED GAS FLOW
Juergen W. Beck *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 95–116 refs Sponsored by Deut. Forschungsgemeinschaft (See N67-13842 04-12)

The aerodynamic coefficients (lift, drag, pitching moment) of symmetrical wing profiles and fuselages (with and without nose radius) are calculated for the free molecular flow. Also for some selected wings with finite span and plate profile, the coefficients of rolling and yawing moments due to rolling are calculated as functions of the speed ratio. In general, the aerodynamic coefficients depend on the wall temperature. Therefore, this temperature is obtained taking into account all effects, especially the influence of radiation exchange with the earth. The numerical calculations of the wall temperature are carried out as function of the speed ratio for some special cases. For the numerical calculations the accommodation coefficients were assumed to be equal to one (diffuse reflection). However, their effect on the aerodynamic coefficients is discussed. Finally, flows at higher gas densities are treated. A new assumption for the transition regime is applied to the Couette-flow. The drag coefficient is evaluated for the entire range of Knudsen numbers. Author

N67-14107# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
DETERMINATION OF THREE-DIMENSIONAL NON-STATIONARY AERODYNAMIC FORCES [DETERMINATION DES FORCES AERODYNAMIQUES INSTATIONNAIRES TRIDIMENSIONNELLES]
L. Darovsky and R. Dat Paris, AGARD, Jun. 1965 58 p refs In FRENCH; ENGLISH summary Presented at 20th Meeting of "Struct. and Mater." Work Group, Munich, 9–15 Jun. 1965
(AGARD-512) CFSTI: HC $2.50/MF $0.50

The determination of aerodynamic forces, which forms an important part of aeroelastic calculations, has for a long time been based on the method of discrete elements. This method, which uses the results of two-dimensional flow theory, applies fairly well to wings of large span, for which the idea of separate elements is quite logical. On the other hand, it is difficult to justify its application to modern aeroplanes, which are of small span. In this case, the problem is that of a lifting surface being distorted chordwise and spanwise in three-dimensional flow. After linearisation, this leads to an integral equation for which it is possible to find approximate numerical solutions. This calculation, as well as the determination of generalised forces, is now done automatically. Consideration is given to the problem of a wing in subsonic flow, a wing in supersonic flow with subsonic leading edge and supersonic trailing edge, and a control surface in supersonic flow. The different methods used are described and a justification of them is given in the form of a comparison of theoretical and experimental results. Author

N67-14164# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
THE EFFECT OF CROSS-SECTION DISTRIBUTION ON THE STATIC STABILITY CHARACTERISTICS OF AXI-SYMMETRIC BODIES AT MACH NUMBERS OF 5.35 AND 6.71
J. F. Reilly Jun. 1966 72 p refs
(VKI-TN-32) CFSTI: HC $3.00/MF $0.75

An investigation has been made at hypersonic Mach numbers to determine the effects of cross-section distribution on the static stability characteristics of bodies of revolution and to obtain the aerodynamic characteristics of these bodies. All of the bodies tested had the same length and all were circular in cross-section. The bodies tested were conic, bi-conic, and tri-conic. The tests were performed at Mach numbers of 5.35 and 6.71, and at unit Reynolds numbers from 1.5×10^5 to 3.2×10^5 per centimeter. The results indicate that under certain test conditions a body with a forecone followed by a frustum or frustum-flare combination exhibits, through the flow mechanism on the upper quarter of the body, an adverse center of pressure travel in the low angle of attack region (0 to 5 degrees). For a given moment reference point this yields both stable and unstable trim-points. Author

N67-14182# University Coll., London (England). Dept. of Physics.
THE THEORY OF AEROELASTIC BENDING OF AN UPPER ATMOSPHERE SOUNDING ROCKET AND ITS APPLICATION TO PAYLOADS ON NIKE-CAPACHE
H. A. Pfeffer Jul. 1966 79 p refs
CFSTI: HC $3.00/MF $0.50

A review of the theory of static aeroelastic bending of a rocket based on the equations of aeroelastic bending is presented. Certain equations that still differ from these equations are pointed out for further reference. The numerical results of the computations are briefly summarized. In view of the importance of the air loading in the structure calculations, details of the relevant aerodynamics are given and applied to the Nike-Capache configuration. The air load distribution is given. Author (ESRO)

N67-14276# Office National d'Etudes et de Recherches Aeronautiques, Pairs (France).
COMPARED EFFECTS OF THE AERODYNAMIC COEFFICIENTS ON THE AEROELASTIC STABILITY OF AN AIRPLANE AUTOMATICALLY PILOTED [INFLUENCES COMPAREES DES COEFFICIENTS AERODYNAMIQUES SUR LA STABILITE AEROELASTIQUE D'UN AVION PILOTE AUTOMATIQUEMENT]
Jacques Bouttes and Phillippe Cazin [1966] 34 p refs In FRENCH Presented at the 3rd A.F.I.T.A.E. Colloq. on Appl. Aerodyn., Marseille-Istres, France, 8–10 Nov. 1966 Submitted for Publication
(TP-418) CFSTI: HC $2.00/MF $0.50

A method of calculation allowing the prediction of the risk of aeroelastic instability of an airplane equipped with an anotmatic pilot is described. A simple process providing in first approximation the mathematical form of the aerodynamic loads intervening in the calculations is indicated. The importance of the corresponding coefficients in the determination of the aeroelastic stability conditions is discussed. The results presented concern a large airplane equipped with an artificial pitch damper. Author (ESRO)

N67-14279# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
FORCE AND MOMENT TESTS ON A 1:40 SCALE MODEL OF THE ELDO SATELLITE LAUNCHING VEHICLE IN A 1.20×1.20 M^2 SUPERSONIC BLOWDOWN TUNNEL S.S.T. OF THE NLR
P. L. W. Arts and J. H. A. Te Boekhorst 13 Oct. 1965 68 p refs
(NLR-TR-6-37) CFSTI: HC $3.00/MF $0.75

Six component force and moment measurements have been conducted in the Mach number range of 1.4 through 3.9. Three different nose shapes have been investigated. The angle of attack was varied from −5° to 12°. The results, as obtained from these measurements, are free from serious irregularities and fit well to the results in the transonic speed range as obtained by measurements in the NLR transonic wind tunnel. ESRO

N67-14280# Office National d'Etudes et de Recherches Aeronautiques, Pairs (France).
WIND-TUNNEL STUDY OF A HYPERSONIC REENTRY LIFTING BODY [ETUDE AERODYNAMIQUE D'UN CORPS DE RENTREE PORTANT EN HYPERSONIQUE]
René Ceresuela [1966] 29 p refs In FRENCH; ENGLISH summary presented at the Ann. Joint Meeting DGRR/WGLR, Bad-Godesberg, West Germany, 4–5 Oct. 1966 Submitted for Publication
(TP-409) CFSTI: HC $2.00/MF $0.50

A lifting reentry body has been tested up to Mach numbers 16.5, and at angles of attack up to 50°. When compared to the Newtonian predictions the wind tunnel test results outline the limitations of this theory, namely with regard to the interaction of the blunt nose on the aerodynamic field. The efficiency of conventional elevons was investigated, as well as the evolution of the yaw stability as a function of the Mach number and of the angle of attack; the good performance of twin lateral fins is explained. The kinetic heating rate distribution at high angles of attack measured by means of thermosensitive paints is discussed. Author (ESRO)

N67-14284# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENTROPY EFFECTS IN THREE-DIMENSIONAL HYPERSONIC FLOWS OF GAS OVER SLIGHTLY BLUNT-NOSED BODIES
V. V. Sychev 13 Apr. 1966 9 p refs Transl. into ENGLISH from Arch. Mech. Stosowanej (Poland), v. 16, no. 2, 1964 p 517–519
(FTD-TT-65-1827; TT-66-62431; AD-640289) CFSTI: HC $1.00/MF $0.50

The purpose of the study is to give brief consideration to the asymptotic effect of slight blunting in the case of flow over nonaxisymmetrical bodies, or bodies of revolution moving at angles of attack. Author (TAB)

N67-14287# France. Institut de la Mecanique Statistique de la Turbulence, Marseille.
SCHLIEREN AND HOT WIRE EXPLORATION OF WAKES IN WIND-TUNNEL SUPERSONIC FLOWS [OBSERVATIONS EN SOUFFLERIE DE SILLAGES DANS UN ECOULEMENT SUPERSONIQUE PAR STRIOSCOPIE ET ANEMOMETRIE A FIL CHAUD]
J. Gaviglio (O.N.E.R.A.) and H. Burnage (Fac. of Sci.) Paris, O.N.E.R.A., [1966] 43 p refs In FRENCH Presented at the 3rd A.F.I.T.A.E. Colloq. on Appl. Aerodyn., Marseille-Istres, 8–10 Nov. 1966 Submitted for Publication Sponsored by O.N.E.R.A.
(TP-417) CFSTI: HC $2.00/MF $0.50

Methods of observation of turbulent flows are described in the first part; they are justified by a brief survey of the theories on which they are founded. The advantage of calibrating the anemometers in the conditions of measurement is shown. The measurement equipment is described. Some examples of application to the case of wakes are given. It is also shown how the methods described allow an analysis of the characteristics of these flows as a function of various parameters. Author (ESRO)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N67-13400*# Advisory Group for Aerospace Research and Development, Paris (France).
THE CONTROL MOMENT DISTRIBUTION FOR THE Do 31 HOVERING RIG
G. Schweizer and H. Seelmann Oct. 1965 31 p refs Presented at the 27th Meeting of the AGARD Flight Mech. Panel, Rome, 11–12 Oct. 1965
(AGARD-522) CFSTI: HC $2.00/MF $0.50 CSCL 05D

An attempt was made to ascertain the thrust control moments necessary under various flight conditions from flight results obtained on the DORNIER hovering rig for the VTOL transport aircraft, Do 31. The moments actually required during flight for different control systems and under various external flight conditions were recorded and compared with control moments. Test reulsts from the Hawker Siddeley VTOL fighter P 1127 were also taken into consideration. Author

N67-13901# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
PROPELLER, INTEGRAL GEARBOX MODEL 73EGB1 AND PROPELLER, VARIABLE CAMBER MODEL VC86260 Flight Test Report
Douglas K. Leishman 30 Jun. 1966 181 p
(Contracts NOw-64-0635-d; NOw-65-0533-d)
(HSER-4076; AD-638632) CFSTI HC $5.00/MF $1.00

A 50 hour flight test was conducted on both the 73EGB1 and VC86260 propellers. These tests were conducted on the B-17G test bed aircraft which was removed from long time storage and reconditioned. A 73EGB1 gearbox was modified to a shaft configuration for use in VC6260 propeller flight test. Development tests and a 50 hour engine PFRT were conducted on this gearbox. Both test propellers and gearboxes were assembled primarily from

hardware used in development testing programs on the 73EGB1 and VC86280 propellers. In general, both propellers performed satisfactorily during their respective tests. Author (TAB)

N67-13907# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.
XV-5A LIFT FAN FLIGHT RESEARCH AIRCRAFT. PHASE I FLIGHT TEST RESULTS, VOLUME III
Mar. 1966 248 p
(Contract DA-44-177-TC-715)
(Rept.-166, Vol. III; AD-639233) CFSTI: HC$6.00/MF$1.25

A series of graphs illustrate the following parameters of the XV-5A lift fan flight testing at various speeds: (1) steady-state sideslips, (2) longitudinal control disturbance, (3) rudder and bank rolls, (4) directional and longitudinal control input, (5) hover flight, (6) horizontal tail angle of attack incidence, (7) STOL operation time histories, (8) horizontal stabilizer time histories and downwash, (9) longitudinal and lateral stability checks, (10) takeoff with 15 and 30° flaps with different loads, (11) wind-up turns, and (12) accelerated stalls in left and right turns. M.W.R.

N67-14110# Royal Aircraft Establishment, Bedford (England).
RESULTS OF FLIGHT TESTS ON THE SHORT SC1 VTOL RESEARCH AIRCRAFT WITH PARTICULAR REFERENCE TO HANDLING QUALITIES IN THE HOVER AND TRANSITION
H. W. Chinn Paris, AGARD, Oct. 1965 34 p refs Presented at 27th Meeting of the AGARD Flight Mech. Panel, Rome, 11–12 Oct. 1965
(AGARD-527) CFSTI: HC$2.00/MF$0.50

Results are given of flight tests made on the Short SC1 jet VTOL research aircraft covering control and stability characteristics and performance throughout the flight envelope, but with particular reference to the hover and transition. Pilots' assessments of the aircraft in different conditions are considered in relation to its measured characteristics and such features as cockpit layout, view and control arrangement which can have an important influence on the overall flying qualities. Author

N67-14118# Aeronautical Research Inst. of Sweden, Stockholm.
STATISTICAL MAGNIFICATIONS OF SONIC BOOMS BY THE ATMOSPHERE
Robert Dressler and Nils Fredholm Jun. 1966 20 p refs
(FFA-104) CFSTI: HC$1.00/MF$0.50

Investigated was statistical scatter in Δp-magnification m due to large-scale atmospheric effects of wind and temperature for steady-state cruise. Justification is made for use of linear theory for pressure ratios in the far-field. The geometrical acoustic approximation is also justified; Fourier transforms of N-waves show, by analogy with optics, that the accuracy is sufficient for statistical purposes. For cruise at Mach number 2.2 and 50,000 feet, a Monte-Carlo analysis by computer obtains relative overpressures at ground for 480 random atmospheres. These exhibit realistic wind-temperature statistics. The program calculates each entire boom carpet, selects the maximum Δp wherever it occurs, and computes its ratio to peak Δp for the Standard Atmosphere. Results show that the nominal value is the median of m, not the mean, which is considerably higher. The calculated distribution for m is log-normal between values 1.3 and 3.0. On the average, a Δp-magnification at least twice the peak nominal occurs in cruise once in 110 flights, and three times occurs once in 500 flights. Extrapolation indicates that once in 2000 flights a magnification at least four times would occur. Author

N67-14124# Aeronautical Research Council (Gt. Brit.).
FLIGHT MEASUREMENTS OF THE DRAG OF A SWEPT-WING AIRCRAFT (HUNTER MK. I) AT MACH NUMBERS UP TO 1.2, TOGETHER WITH SOME MEASUREMENTS OF LIFT-CURVE SLOPE
D. R. Andrews and J. E. Nethaway London, HMSO, 1966 27 p refs Supersedes ARC-17947
(ARC-R&M-3420; ARC-17947) CFSTI: HC $2.00/MF $0.50

Flight tests have been made to determine the drag of a Hawker *Hunter* F Mk. I aircraft. The results show that at low Mach number the drag coefficient at zero lift is 0.0125 and the effective induced-drag factor K is 1.09, both values being corrected to a constant Reynolds number of 34×10^6. Above a certain C_L the drag due to lift increases rapidly, the C_L at which this occurs falling from 0.76 at M=0.3 to 0.41 at M=0.7. Some approximate measurements of K made at supersonic speeds suggest that virtually all the leading-edge suction on the wing is lost beyond M=1.0. At C_L=0.1, the compressibility drag rise commences soon after M=0.8, the drag rising rapidly beyond M=0.92 and attaining a peak C_D of 0.0565 at M=1.15. The compressibility drag rise obtained from high-speed wind-tunnel tests agrees well with that obtained in flight. Measurements of incidence show that the lift-curve slope at M=0.3 is 3.5 rising to 4.6 at M=0.9. The zero-lift angle remains constant with Mach number at about 0.4°. Agreement with wind-tunnel tests is reasonably good when allowance is made for differences in geometry and in Reynolds number. Author

N67-14321# Toronto Univ. (Ontario).
THE LIGHT-LINE-TETHERING TECHNIQUE FOR DETERMINING THE AERODYNAMIC DERIVATIVES OF AN AIR CUSHION VEHICLE Final Technical Report, Oct. 1960–May 1965
G. Kurylowich Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jun. 1966 133 p refs
(Contract AF 33(657)-8451)
(AFFDL-TR-65-159; AD-640209) CFSTI: HC $4.00/MF $1.00

A complete feasibility study was performed on a new technique for determining ACV aerodynamic derivatives. A circular track simulated 'ground' while the vehicle, tethered to a centerpost by means of light cable, flew a circular flight path above the track surface. A step on the 'ground' perturbed the vehicle from equilibrium and the resulting oscillations were recorded by a movie camera. The results obtained indicated that many derivatives were functions of height. Although scatter in the data permitted a qualitative study only, it was concluded that the scatter resulted from random errors in the recorded time histories and the manner in which the cable was attached to the vehicle. By making certain improvements in the experimental design and apparatus (especially using a larger track) it was concluded that all derivatives could be obtained with satisfactory precision with this technique. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N67-13655# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF AN ADSORPTION CESIUM RESERVOIR Quarterly Technical Report
Jun. 1966 39 p
(Contract AT(30-1)-3642)
(NYO-3642-2; QTR-2) CFSTI: HC$2.00/MF$0.50

Research is described leading to the development of a thermionic converter with a self-contained, self-regulating, high-temperature, adsorption reservoir for the automatic control of cesium pressure. A study of reservoir materials and geometries is described. Liquid reservoirs are compared with adsorption reservoirs. NSA

N67-13861*# Moog Servocontrols, Inc., East Aurora, N. Y.
RELIABILITY ANALYSIS AND PREDICTION MOOG MODEL 17-200B MECHANICAL FEEDBACK SERVOACTUATOR GMSFC, NASA PART NO. 50M35008, REV. B
G. B. Le Roy 26 Oct. 1966 143 p refs
(Contract NAS8-18060)
(MR-1062, Rev. A) CFSTI: HC $4.00/MF $1.00 CSCL 13G

The servoactuator basically consists of a forged body, a cylinder, a double-anded piston, a three stage flow control servovalve, and a mechanical feedback mechanism. The reliability analysis was carried out on the production configuration of the servoactuator and consisted of the following four major tasks: (1) margin of safety analysis; (2) review of failure experience; (3) failure mode and effects analysis; and (4) the reliability prediction. A review of detail drawings provided the basis for the margin of safety analyses of critical design areas. These analyses were then used to determine structural failure modes. All failure experience was reviewed and assessed for adequacy of corrective action and indications of potential failure modes. Testing associated with such failure experience is discussed. K.W.

N67-13729*# Aeroflex Labs., Inc., Long Island City, N. Y.
[INVESTIGATION LEADING TO THE DESIGN OF AN IMPROVED TYPE OF JET VANE ACTUATOR] Interim Report
14 Jul. 1966 44 p
(Contract NAS7-100; JPL-950897)
(NASA-CR-80744) CFSTI: HC $2.00/MF $0.50 CSCL 13G

Efforts performed during this period on the development of an improved jet vane actuator design are summarized. Included are accumulated data, an analysis of a pivot flexure, and two possible approaches to their use in a breadboard jet vane actuator. R.N.A.

N67-13884# Compagnie Generale de Telegraphie sans Fil, Orsay (France).
CAPILLARY TRANSMITTER OF CESIUM IONS: APPLICATION TO THERMIONIC CONVERTERS [EMETTEUR CAPILLAIRE D'IONS DE CESIUM: APPLICATION A DES CONVERTISSEURS THERMOIONIQUES]
H. Huber and R. Le Bihan *In* AGARD Phys. and Technol. of Ion Motors 1966 p 103–137 refs In FRENCH (See N67-13881 04-28)

An expansion of the principle of capillary emission as a source of both electrons and cesium ions is presented. In considering the charge distribution inside an infinitely long cylinder, the interior wall of which emits either electrons or ions, it is shown that this type of cylinder is of interest as an electron or ion source of high current density only when its radius is sufficiently small. Even for these cylinders, the section presents a current density lower than that of the interior wall. In the case of simultaneous emission of positive ions and electrons, a plasma is formed which may serve as a source of current density electrons more important than the cylinder wall. This takes place under certain conditions in the capillary emitter when passing a cesium gas through a capillary tube of refractory metal that is heated at a high temperature (1500° to 2200°K). Agreement between experimental and theoretical results is considered satisfactory. Transl. by R.LI.

N67-13894# Compagnie Francaise Thomson-Houston, Bagneux (France).
THERMIONIC CONVERSION OF ENERGY [LA CONVERSION THERMOIONIQUE DE L'ENERGIE]
J. E. Picquendar *In* AGARD Phys. and Technol. of Ion Motors 1966 p 359–374 In FRENCH (See N67-13881 04-28)

As one of the principal problems for satellite application, space propulsion requirements from more powerful electric energy sources are specified. Principles of thermionic conversion are analyzed under the aspects of basic physical phenomena, power loss, neutralization, and different types of converters, including pure metal emitters. Details are also given on homogeneous and nonhomogeneous emitters. The problem is posed of concentration of radiation to raise the thermionic converters to high temperature, and several solutions are envisaged. Nuclear energy is mentioned as another source of useful power from an on-board nuclear reactor Transl. by R.LI.

N67-13895# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt e.V., Cologne (West Germany). Inst. fuer Energiewandlung und Elektrische Antriebe.
DEVELOPMENT TRENDS IN THE FIELD OF THERMIONIC ENERGY CONVERTERS IN GERMANY
Eugen M. Knoernschild *In* AGARD Phys. and Technol. of Ion Motors 1966 p 375–389 refs (See N67-13881 04-28)

Activity in the field of thermionic converters encompasses vacuum magnetic triodes, cesium diodes and noble gas triodes. Theoretical investigations indicate that the important loss mechanism in vacuum triodes with superposed magnetic field is the scattering of electrons on their curved path from emitter to collector. Electron trajectories for two configurations of magnetic triodes are discussed. In the field of cesium diodes the main emphasis is on arc mode operated converters. Efforts are directed toward increasing the optimum spacing between emitter and collector by the use of cesium fluoride. A cesium coating on a substrate of fluorine on tungsten permits a considerable larger spacing of the electrodes. Further investigations are concerned with the plasma resistance for normal and arc mode operation. A strong influence of the spacing with arc mode operation on power output of the diode has been noted. In the field of noble gas triodes several configurations are being tested. Promising results have already been obtained. A few test data on the various configurations are presented. The possibility of intermittently generating ions followed up by emission of electrons is investigated. An optimum gas pressure can be established where the loss of ions, due to diffusion and recombination, is a minimum. Author

N67-14027# Atomics International, Canoga Park, Calif.
POWER SUPPLY INSTALLATIONS FOR FUTURE SPACECRAFT
Franz Grob, Reinhart Langpape, and Kurt Stahl 1966 20 p refs Transl. into ENGLISH from BBC-NACHR. (Germany), v. 48, 1966 p 156–172
(AI-TRANS-209)

A detailed comparison of the different methods of energy production in space is presented. The advantages and disadvantages of each are outlined. NSA

N67-14083# Aeronutronic, Newport Beach, Calif.
ORGANIC RANKINE CYCLE FEASIBILITY DEMONSTRATION PROGRAM Quarterly Report, 15 Apr.–30 Jun. 1966
H. D. Linhardt 30 Jun. 1966 39 p refs
(Contract AT(04-3)-650)
(U-3673; SAN-650-1) CFSTI: HC $2.00/MF $0.50

The performance potential of the organic Rankine cycle working fluid monoisopropylbiphenyl (MIPB) for long duration space power applications was evaluated. For durations less than 100 hours, the feasibility of achieving high component and cycle efficiencies when using MIPB as Rankine cycle working fluid was demonstrated. A 65-watt, 16-pound prototype engine demonstrated a high degree of confidence in overall performance for the development of 1.5 to 20 kw(e) MIPB power plants. Component efficiencies increase with increased power levels and the fundamental design of the organic MIPB power plant remains unchanged. This design consists of the forced recirculation boiler and the turbine motor driven recirculation and system pump unit. Both were selected for prevention and control of fluid hot spots, and the minimization of connections and welds in order to eliminate oxygen loop contamination during ground testing. The analysis and preliminary design effort connected with the fluid properties evaluation are presented. Test loops have been sized to correspond to the operating conditions of 1.5 kw(e) power conversion system having a boiler exit temperature of 850°F

and a condenser pressure of 1 psia. Each test loop consists of a forced circulation boiler with separator, regenerator, condenser, turbine-motor driven multipump, controls, instrumentation and a turbine simulation device. The test loops are designed for hermetic, unmonitored and continuous operation for 10,000 hours. The preliminary design of the 1000-hour endurance loop is presented, including cycle analysis and discussion of component selection. Finally, the test facility, the preliminary test plan, and the program schedule are discussed. NSA

N67-14214*# TRW Systems, Redondo Beach, Calif.
NICKEL-CADMIUM CELL HEAT STERILIZATION TEST PROGRAM, PHASE I Final Report
R. N. Richards Oct. 1966 232 p Prepared for JPL
(Contracts NAS7-100; JPL-951092)
(NASA-CR-80829) CFSTI: HC $6.00/MF $1.25 CSCL 10A

Tests were conducted to determine the capability of nickel–cadmium cells to perform after being subjected to three 36-hour heat sterilization cycles at 145° C. After heat sterilization, life, open circuit storage, and constant current float tests were included in the program. Performance characteristics of nonsterilized cells and sterilized cells were compared to determine the effects induced by heat sterilization. Test conditions are detailed, and data are graphically presented. Results show that cells cannot withstand the sterilization process while in a charged condition without a high probability of subsequent failure or erratic or abnormal behavior. Sterilization in the discharged– shorted condition produced a general and immediate loss of about 25% of initial capacity, but continued cycling showed little additional loss in capacity and consistent charge–discharge characteristics up to the end of the 300-cycle test. M.G.J.

N67-14340# Royal Aircraft Establishment, Farnborough (England).
PARTICIPATION IN THE DEVELOPMENT OF CADMIUM SULPHIDE SOLAR CELLS ON A FLEXIBLE SUPPORT [PARTICIPATION A LA MISE AU POINT DE CELLULES SOLAIRES AU SULFURE DE CADMIUM SUR SUPPORT SOUPLE]
May 1966 40 p Transl. into ENGLISH from French
(RAE-LIB-TRANS-1162) CFSTI: HC $2.00/MF $0.50

Techniques for the fabrication of thin film polycrystalline cadmium sulphide solar cells on plastic and metal foil substrates are described. The research effort was aimed at improving the reproducibility of the solar cell characteristics, their protection from atmospheric contamination, and improvements to series connections. Power output to weight ratios between 15 and 25 w/kg are claimed for 0.2% efficient cells embodying an aluminum substrate and 9 w/kg for 0.1% efficient cells embodying a plastic substrate. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N67-13404# Technology, Inc., San Antonio, Tex. Life Sciences Div.
A STUDY OF THE PRODUCTION OF CHORIORETINAL LESIONS BY THERMAL RADIATION
Thomas A. Alexander, Ralph G. Allen, Jr., Roger L. Bessey, Earl R. Lawler, Jr., and William R. Bruce *In its* Res. on Ocular Effects Produced by Thermal Radiation Jul. 1966 25 p refs (See N67-13401 04-14) CFSTI: HC $4.00/MF $1.00

Chorioretinal burns have been systematically produced in pigmented rabbits under carefully controlled laboratory conditions. Lesions were produced by high-intensity light flashes ranging in duration from 165 microseconds to 250 milliseconds and with image diameters which ranged from 1.0 mm to 0.11 mm. From these measurements relationships were obtained between exposure duration and threshold irradiance for the production of 5-minute minimal lesions. Author

N67-13405# Technology, Inc., San Antonio, Tex. Life Sciences Div.
AN EXAMINATION OF THE PRODUCTION OF CHORIORETINAL BURNS IN TERMS OF TEMPERATURE DISTRIBUTIONS
Ralph G. Allen, Jr., Arthur F. Muller, Earl R. Lawler, Jr., and William R. Bruce *In its* Res. on Ocular Effects Produced by Thermal Radiation Jul. 1966 39 p refs (See N67-13401 04-14) CFSTI: HC $4.00/MF $1.00

The eyes of an adult rabbit were subjected to a series of controlled exposures to investigate the relationship between ophthalmoscopically visible results and the temperature rise produced in the chorioretinal region. Minimally visible effects were associated with a temperature rise in the pigment epithelium of 15–20°C for the exposure condition investigated. At temperatures above 20°C lesions appeared almost immediately and were approximately the size of the image on the retina, or somewhat larger. For temperature increases of 15–20°C the appearance of visible change was delayed several hours and the size of the disturbed area was considerably less than the image size. It was concluded that a simple temperature criterion seems to be inadequate for a quantitative description of the extent of visible changes and/or the model used for calculating the temperature distributions may not be adequate. S.P.

N67-13421# Joint Publications Research Service, Washington, D.C.
REPORTS PRESENTED AT SOVIET CONFERENCE ON SPACE BIOLOGY AND MEDICINE
A. V. Lebedinsiy, ed. 10 Nov. 1966 156 p refs Transl. into ENGLISH of the book "Materialy Konferentsii Po Kosmicheskoy Biologii i Meditsine" Moscow, Acad. of Med. Sci. USSR, 1966 p 1–150
(JPRS-38596; TT-66-35021) CFSTI: $4.00

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N67-13422# Joint Publications Research Service, Washington, D. C.

GENERAL PATTERNS OF REACTIONS OF THE HUMAN BODY TO THE COMBINED EFFECT OF THE TYPICAL ENVIRONMENTAL FACTORS IN SPACECRAFT CABINS

A. V. Lebedinskiy, S. V. Levinskiy, and Yu. G. Nefedov *In its* Rept. Presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 1–8 (See N67-13421 04-04) CFSTI: $4.00

Special chamber tests lasting from 10 to 120 days were performed to investigate human reactions to a prolonged stay in a hermetically sealed and limited space. Analysis of immunological reactivity changes of the subjects and correlation of these data with changes in the environmental microflora showed a quantitative increase of microorganisms that vegetate on the skin and thus significantly increased bacterial contamination of the cabin atmosphere. Also observed was carbon monoxide excreted from the human body and accumulated in the air. This autointoxication increased the gas pressure in the alveolar air and influenced the regulatory mechanisms of external respiration and tissular gas metabolism. Complex physiological examinations during 120-day tests showed that the observed sound sleep inhibition was marked by a decrease or total absence of delta waves from the EEG's. Standardization of living conditions and a strict activity schedule during the day developed in all subjects an imposed performance stereotype for most physiological functions. G.G.

N67-13426# Joint Publications Research Service, Washington, D. C.

SOME MEANS OF REDUCING BACTERIAL PROPAGATION DURING PROLONGED SPACE FLIGHTS

V. V. Borshchenko, M. I. Kozar, F. K. Savinich, and G. V. Shcheglova *In its* Rept. Presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 27–31 refs (See N67-13421 04-04) CFSTI: $4.00

The addition of antibacterial properties to materials used in the manufacture of equipment, clothing, items of personal hygiene of the astronauts, and in the lining of the occupied spaces of the spacecraft is discussed. Most desirable is the attachment of bactericidal agents in the micromolecules of fibrous polymers by ionic, covalent, or coordinated chemical bond whereby the fibers and fabrics acquire long persisting antibacterial properties. The stability of the antibacterial effect is related to the type of bond between the bactericide, the polymer, and the nature of the bactericide. Preliminary results of antibacterial activity and hygienic properties of textiles chemically bonded with bactericides reveal that cellulose fibers possess a modified activity against staphylococcus aureus. G.G.

N67-13429# Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF CEREBRAL AND CARDIAC OXYGENATION ON PHYSIOLOGICAL FUNCTIONS

Ye. A. Kovalenko, V. L. Popkov, Ye. A. Il'in, V. I. Korol'kov, and I. N. Chernyakov *In its* Rept. Presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 51–52 (See N67-13421 04-04) CFSTI: $4.00

Altitude tests in connection with polarographic determination of cerebral, cardiac, and blood oxygen pressure during centrifuging were used to simultaneously record the indices of various physiological functions and the dynamics of gases in body tissues during exposure to space flight conditions. Experiments with hypoxic and hyperoxic gas mixtures established correlations between oxygen pressure in brain tissue and heart tissue, as well as between the dynamics of oxygen pressure, carbon dioxide pressure, and helium pressure in the arterial, venous, and capillary blood when the gas environment changed. Experiments with hypercapnic and hypoxic mixtures found a direct correlation between the degree of cerebral oxygenation and the degree of hypercapnia; ascents to different altitudes produced changes in the main physiological functions. A significant deoxygenation in cerebral and cardiac tissues was observed under the influence of accelerations varying in magnitude and duration. G.G.

N67-13431# Joint Publications Research Service, Washington, D. C.

ACCLIMATIZATION TO MOUNTAINS AS A MEANS OF INCREASING CONSTITUTIONAL RESISTANCE TO OXYGEN SHORTAGE AND OTHER EXTREME FACTORS IN SPACE FLIGHT

N. A. Agadzhanyan, L. A. Bryantseva, and G. A. Davydov *In its* Rept. Presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 65–76 refs (See N67-13421 04-04) CFSTI: $4.00

Analyses of data obtained both in the mountains and in pressure chamber tests showed that increased constitutional resistance to hypoxia and other extreme factors during prolonged acclimatization in the mountains is the result of activation and intensification of pulmonary respiration, cardiac function, etc. Most important are adaptational changes in cell energy metabolism as indicated by the long persistence of the acclimatization effect. It was concluded that mountain climbing increases also the endurance of prolonged isolation, monotony, temperature fluctuations, humidity, high ultraviolet, infrared and cosmic radiation; astronauts should remain in a mountainous region at an altitude of 3000 to 5000 meters for 40 to 50 days prior to prolonged space flights. G.G.

N67-13435# Joint Publications Research Service, Washington, D. C.

SOME ASPECTS OF THE PSYCHOPHYSIOLOGY OF ISOLATION AS APPLIED TO PROLONGED SPACE FLIGHTS

F. D. Gorbov and F. P. Kosmolinskiy *In its* Rept. Presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 118–122 refs (See N67-13421 04-04) CFSTI: $4.00

Research on the influence of isolation and monotonous surroundings on man is being reviewed. Various studies established that prolonged restriction to a small space under conditions of isolation from the outside world blocked sensory input and impaired the ability to think productively. Experiments with partial isolation in which the sense organs were not blocked developed fatigue in the subjects with sleep disorders, difficulty in falling asleep, and awakening independently. After extended isolation, most subjects revealed a difference in sensitivity of their sense organs to distant threshold stimuli and took a relatively long time to recover their athletic former efficiency. G.G.

N67-13436# Joint Publications Research Service, Washington, D. C.

THE CRITERIONAL METHOD OF RESEARCH IN BIOLOGY AND MEDICINE

Yu. N. Sushkov *In its* Rept. Presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 123–138 (See N67-13421 04-04) CFSTI: $4.00

Described is a mathematical model for statistical processing of experimental biological and medical research data, the planning of experiments and diagnoses of diseases, as well as for results obtained on the strength of the first lumbar vertebra of man. This method characterizes each property of a medico-biological object by its own criteria, retains a constant value for the criterion of a group of homogenous objects, measures the numerical value of the criterion of a given object, relates the biological phenomenon to the quantity of variables in the criterion, and evaluates the possibility of performing statistical processing of relatively few experiments. Sample calculations for determining the static strength of the first lumbar vertebra from thirteen random experiments show that with age the strength of the human vertebra diminishes. Mean quadratic and maximum deviations of vertebral strength calculated by the criterion method are lower than corresponding deviation values based on ordinary statistical processing of experimental results. G.G.

N67-13437# Joint Publications Research Service, Washington, D. C.

A METHOD OF EVALUATING THE FUNCTIONAL STATE OF THE DOG'S DENERVATED HEART. PROBLEMS PERTAINING TO INVESTIGATION OF RELIABILITY OF THE HEART

R. M. Bayevskiy, V. P. Demikhov, and N. M. Sharovskaya *In its* Rept. Presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 139–142 refs (See N67-13421 04-04) CFSTI: $4.00

A dog with two hearts, the natural one remaining attached only to the right carotid artery with intact neural connections and the transplanted heart connected to the left carotid and free of neural connections with the central nervous system, was studied by implanted electrodes to obtain data characterizing the contractile function of the myocardium. A method of variation pulsometry analysis showed that the denervated heart operated within a very narrow frequency band, much lower than the heart with intact neural connections. G.G.

N67-13438# Joint Publications Research Service, Washington, D. C.

THE MECHANISM OF THE SEASICKNESS SYNDROME

B. B. Bokhov *In its* Rept. Presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 143–144 refs (See N67-13421 04-04) CFSTI: $4.00

The appearance of various combinations of excitation and inhibition signals in the receptive field of the vestibular analyzer impairs the normal course of vestibular reactions and leads to sensory disturbances associated with marked vegetative shifts. Training of subjects exposed to Coriolis accelerations diminishes or extinguishes these reactions. The same principle can be applied to disturbances observed during weightlessness: appearance of unfamiliar configurations of excitation due to the disappearance of gravitational forces acting upon the otolithic plate. G.G.

N67-13439# European Atomic Energy Community, Brussels (Belgium).

INVESTIGATIONS BY EMISSION SPECTROGRAPHY ON PLANKTON SAMPLES OF KNOWN BIOLOGICAL COMPOSITION [EMISSIONSSPEKTROGRAPHISCHE UNTERSUCHUNGEN AN PLANKTONPROBEN BEKANNTER BIOLOGISCHER ZUSAMMENSETZUNG]

H.-J. Bielig, H.-L. Schmidt, G. Rohns, and E. Klinger Sep. 1966 29 p refs In GERMAN

(EURATOM-015-62-2-BIOB)

(EUR-2771.d) CFSTI: HC $2.00/MF $0.50

Comparison of the blackening of selected absorption lines in the spectra of plankton ashes and of artificial ashes of known elementary composition, permitted quantitative determination of the amount of the following 13 bioelements: P, Cs, Sr, Ca, Cu, Zn, V, Cr, Mn, Mo, Fe, Co, and Ni. The content of Ag as an accidental trace element has been established. The amount of Si was obtained from the loss of weight after treatment with hydrofluoric acid. There is in nearly all cases parallelism between the frequency of diatomes and the amount of Si in the different plankton samples. Generally the contents of Ca and Sr are found to be in constant relation. The total uptake of bioelements from 1 m^3 of sea water by the plankton contained in it, lies independently of the collection place, lower than 1% of the amount present. Possible reasons for the higher uptake of Cs and Fe are discussed. An enrichment factor ≥ 100 of biolements in the plankton ashes has been found only for P, Cs, and Zn; in some cases this has been established also for V, Fe, and Co. Author

N67-13441# Joint Publications Research Service, Washington, D. C.

SIMULATION IN BIOLOGY AND MEDICINE

N. N. Amosov, S. L. Aleyev, and V. G. Mel'nikov, ed. 29 Sep. 1966 177 p refs Transl. into ENGLISH of the book "Modelirovaniye v Biologii i Meditsine" Kiev, Naukova Dumka Press, 1965 p 1–188

(JPRS-37900; TT-66-34328) CFSTI: $5.00

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N67-13442# Joint Publications Research Service, Washington, D. C.

SIMULATION IN BIOLOGY AND BIOCYBERNETICS

N. M. Amosov and Yu. G. Antomonov *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 2–8 refs (See N67-13441 04-04) CFSTI: $5.00

Theoretical questions concerning the application of biocybernetics to the solution of medical and physiological problems are discussed. S.C.W.

N67-13443# Joint Publications Research Service, Washington, D. C.

SOME GENERAL PROBLEMS OF THE PHYSIOLOGY OF THE NERVOUS SYSTEM AND CYBERNETICS

N. L. Gorbach and A. A. Bogomolets *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 9–12 (See N67-13441 04-04) CFSTI: $5.00

Inherent problems associated with the development of mathematical models for studies of the physiology of the higher nervous system are discussed. On the basis of I. P. Pavlov's studies of human behavioral mechanisms, the adoption of the technical principles of switching on and interrupting the nerve connections for processing a nerve current is suggested as a possible approach in the development of more accurate parallels between the functioning of cybernetic machines and between the proposed mechanisms of higher nervous activity. The use of the theory of nerve networks for the simulation of behavior mechanisms on a neuron-synaptic level is discussed. Suggested is the replacement of the single-pulse (binary) code and the instantaneous strongly synchronized interaction of the pulse-frequency alphabet in a sliding (asynchronized) time interval. Thus, the fundamental structure and logical-mathematical framework of the theory remains intact, and to a first approximation, can be widely applied to neurophysiology as an adequate heuristic model. An example which considers the minimum formal and logical network simulating the effect of engaging and disengaging a stimulus is presented which demonstrates that even a very simple neuron model can clearly indicate some structural and time characteristics and, consequently, some approaches to the study of a given neurophysiological phenomenon. S.C.W.

N67-13444# Joint Publications Research Service, Washington, D. C.

USE OF CYBERNETIC METHODS IN PHYSIOLOGY

N. M. Amosov and V. A. Lishchuk *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 13–23 refs (See N67-13441 04-04) CFSTI: $5.00

Methods of cybernetics for use in the development of physiological models of diseased organs and systems which focus on the optimum control of medical treatment are described. Emphasized is the use of quantitative methods in diagnostic medicine. S.C.W.

N67-13445# Joint Publications Research Service, Washington, D. C.

CONTROL OF THE ACTIVITY OF SPECIFIC ANATOMIC-PHYSIOLOGICAL STRUCTURES IN THE NORMAL AND PATHOLOGICAL STATES

L. S. Aleyev and S. G. Bunimovich *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 24–29 refs (See N67-13441 04-04) CFSTI: $5.00

Electrodiagnostic techniques used in the therapeutic stimulation and control of neuromuscular physiological functions are discussed. Considered are bioelectric impulse stimulation methods for the control and study of diseases of the peripheral nerves and methods for the stimulation and control of motor disturbances originating from the central nervous system by means of active bombardment with proprioceptive impulses. The use of signals (myogram) which arise in the organism, such as the frequency and vibrational amplitude of the biopotentials which are fundamental characteristics of muscular bioelectrical activity, is suggested as a possible therapeutic approach in the treatment and study of motor malfunctions resulting from central nervous system disturbances. A single-channel system control device which is based on using the pattern of change in the mean value of the cumulative myogram for determining bioelectric activity of different groups of muscles as a function of their state is described. It is surmised that engineering devices designed according to such principles and operating according to a given program may enable the control of motor reactions in the pathological as well as the normal state. S.C.W.

N67-13446# Joint Publications Research Service, Washington, D. C.

THE MEMORY AS AN OBJECT OF BIOLOGICAL RESEARCH

E. T. Golovan', K. A. Ivanov-Muromskiy, A. N. Luk, and V. S. Starinets *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 30–45 refs (See N67-13441 04-04) CFSTI: $5.00

Attempts to develop a storage memory in artificial systems with a search strategy similar to that of the human brain are discussed. Focused upon is the development of systems with a substantial information capacity and a minimal access time for information retrieval from storage. The importance of studies of human brain functions in the development of memory devices is emphasized. Fundamental characteristics of human memory and the relationship of these characteristics to the problem of random access are discussed and models which consider the fundamental properties of memory are presented to illustrate proposed approaches to the simulation of memory characteristics. S.C.W.

N67-13447# Joint Publications Research Service, Washington, D. C.

A NONLINEAR MODEL FOR THE EXCITATION OF NERVE TISSUE

Yu. G. Antomonov *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 46–57 refs (See N67-13441 04-04) CFSTI: $5.00

The applicability of a nonlinear, heterogeneous differential equation with a discontinuous coefficient in the development of a mathematical model for the simulation of the excitation properties of nervous system elements (neurons and nerve fibers) and the general properties of larger units of the nervous system and cerebral cortex (visual and acoustic analyzers) is discussed. A switching function controlling the sign of the unique coefficient was chosen on the basis of the energetic properties of nerve tissue. A mathematical model which describes the electrotonus, the action potential, and the absolute refractive phase was studied by simulating a continuous action on a computer. Results indicated that the model adequately described the properties of nerve tissue. S.C.W.

N67-13448# Joint Publications Research Service, Washington, D. C.

MATHEMATICAL STUDY OF A MODEL FOR THE EXCITATION OF NERVE TISSUE

A. B. Kotova, I. D. Ponomareva, and L. I. Tushenkov *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 58–69 refs (See N67-13441 04-04) CFSTI: $5.00

A nonlinear, first-order differential equation with a discontinuous coefficient is proposed as a model of a nerve tissue:

$$u' = \operatorname{sgn} W\dot{a}u = v,$$

$$W = E_n - \int (v - v_n + v')dt + \int (u + u')x\,dt,$$

where v is the exciting tension, u is the potential of the nerve tissue, E_n is the analog of the threshold value of the internal energy integral, and v_n is the tension threshold. It is known that a dynamic system described by the equation $u' = \operatorname{sgn} W\dot{a}u = v$, is an analog of the excitation of nervous tissue; that is, in such a system exists characteristic threshold mechanisms of adaptation, threshold summation, transformation rhythm, frequency dependence of the responses to the magnitude of the excitation stimulus, and a series of other factors. The objective of the mathematical study is to show that these properties emerge from the special features of the differential equation $u' = \operatorname{sgn} W\dot{a}u = v$; that is, they are determined by those energy considerations which are contained in the choice of the switching function $W = E_n - \int (v - v_n + v')dt + \int (u + u') x\,dt$ for the coefficient of the differential equation. Results of qualitative studies of phase trajectories, and movement of the action potential as a function of the switching function are presented to demonstrate the applicability of differential equations with discontinuous coefficients as mathematical models for biological systems. S.C.W.

N67-13449# Joint Publications Research Service, Washington, D. C.

RHYTHM OF A NEURON MODEL

A. B. Kotova, I. D. Ponomareva, L. I. Tushenkov, and Yu. G. Antomonov *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 70–80 refs (See N67-13441 04-04) CFSTI: $5.00

An analytical study of the rhythm of a neuron model which was performed on a nonlinear MN-7 simulation computer is reported. The model was based on the following nonlinear heterogeneous first-order differential equation with a discontinuous coefficient:

$$u' = \operatorname{sgn} W\dot{a}u = v,$$

$$W = \phi - \int (v - v_n + v')dt + \int (u + u')dt,$$

where v is the exciting stimulation, u is the neuron potential, ϕ is the analog of the threshold value of the external energy integral, and v_n is the stimulation threshold. The switching function $W = \sigma - (v - v_n + v')dt + (u + u')dt$ was also chosen on the basis of the energetic balance of the nervous tissue. Demonstrated is the use of the proposed model in studies of the spontaneous rhythm of neurons with single inputs, multiple inputs, and feedback. On the basis of these studies it is concluded that: (1) A mathematical model constructed on the basis of energy considerations makes it possible to obtain the properties of neurons of various types (active, passive, etc.); (2) The rhythm of spontaneous discharges depends on the value v which is the analog of the indicator for the functional state; (3) The model of a passive neuron with a potential input may serve as transformer of the amplitude of the incoming signal to the frequency; (4) A connection of the output of the neuron model to an excitation input increases the discharge frequency; and (5) A connection of the output of the neuron model to a retardation input decreases the frequency of the discharges. S.C.W.

N67-13452# Joint Publications Research Service, Washington, D. C.

THE HEART AS A CYBERNETIC SYSTEM

V. A. Lishchuk, O. I. Lissova, and S. A. Patskina *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 98–106 refs (See N67-13441 04-04) CFSTI: $5.00

Consideration is given to some problems concerning heart simulation, whereby the heart is regarded as a functionally complete system and its model is regarded as a behavioral algorithm. In addition, separate treatment is given to a complex of four muscular pumps, a system of independent automatic control, and a system of central control which is also automatic. The problems involved in determining an algorithm of heart behavior on an informational level are discussed in four stages: (1) determining the quality and quantity of the required information; (2) obtaining this information from experiments; (3) processing and analysis of the data; and (4) perfecting the obtained model by comparison with the object. R.N.A.

N67-13453# Joint Publications Research Service, Washington, D. C.

EXTRASYSTOLIC ALLORHYTHMIA (MATHEMATICAL MODEL)

V. A. Lishchuk, S. A. Patskina, B. L. Palets, and I. L. Lissov *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 107–116 refs (See N67-13441 04-04) CFSTI: $5.00

A mathematical model is proposed which explains all forms of an extrasystolic allorhythmia from a unique point of view as a result of the same process. The formalization of the description makes it possible to exclude the ambiguous statements of the problem made by various authors. The frequency of impulse generation by an excitation center of the heart depends on the frequency and on the form of respiration. This dependence can change the form of an allorhythmia to a significant extent. For refinement of the proposed model for an allorhythmia, it makes sense to consider the dependence of the contraction frequency of the heart on the respiration, for instance by using the transmission function of Klains. Some experimental and clinical data make it possible to assume that in individual cases the impulsation periods of the sine center and the pathological center are interdependent. R.N.A.

N67-13454# Joint Publications Research Service, Washington, D. C.

PUNCHED CARDS IN THE ANALYSIS OF PHONOCARDIOGRAMS

V. G. Mel'nikov *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 130–139 refs (See N67-13441 04-04) CFSTI: $5.00

Phonocardiography is one of the most important diagnostic methods in the study of the cardiovascular system. The interpretation and statistical analysis of phonocardiographic data requires the extraction of the desired information from a vast amount of different data. Machines, which automatically process the phonocardiographic data coded on punched cards, are of considerable help in solving this problem. Problems related to the setting up of a punched card file for phonograms are discussed. R.N.A.

N67-13455# Joint Publications Research Service, Washington, D. C.

MULTICHANNEL REACTION METHOD IN THE CONTROL OF SOME MOTOR FUNCTIONS

L. S. Aleyev and S. G. Bunimovich *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 140–146 (See N67-13441 04-04) CFSTI: $5.00

Research was conducted to develop a model of a device for the control of motor reactions in men and animals. The research involved: (1) a study of the electrical activity of nerve-muscular structures to establish a stimulation law depending on the degree of contraction; (2) a study of the interaction of muscles and groups of muscles in the fulfillment of motion; (3) a search for an optimum stimulus, i.e., a signal which brings about a threshold contraction at a minimum energy expenditure and with a minimum sensation of pain; (4) and a study of problems related to the optimum control of the motor systems of the organism, including the optimum spatial distribution of electrodes taking up and sending out signals and the establishment of algorithms for the optimum space-time input of control signals. A detailed description of the operation principle of the device is presented. R.N.A.

N67-13456# Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS IN THE ANALYSIS OF MEDICO-PHYSIOLOGICAL STUDIES BY MATHEMATICAL METHODS USING COMPUTERS

Ye. A. Shkabara and M. A. Kulikov *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 147–150 (See N67-13441 04-04) CFSTI: $5.00

An algorithm and a program were developed for the computer analysis of some physiological characteristics and a system of devices were set up for coding, recording, and computer input of medico-biological experimental data. The system can record the physiological characteristics of an organism during an experiment on magnetic tape and enter the obtained experimental data into a computer for analysis. The system can analyze impulse characteristics such as the impulse activity of the neuron, as well as continuous characteristics such as electroencephalograms, electrocardiograms, blood pressure curves, etc. Some problems related to a specific application of this method, i.e., a mathematical analysis by computer of the impulse activity of intermediate neurons of the brain stem and the spinal cord, are discussed. R.N.A.

N67-13457# Joint Publications Research Service, Washington, D. C.

APPLICATION OF SIMPLE METHODS OF CYBERNETICS TO THE COMPLEX EVALUATION OF THE STATE OF ERYTHROCYTES IN CHRONIC LEUCOSES

V. S. Genes and V. D. Sidora *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 151–159 refs (See N67-13441 04-04) CFSTI: $5.00

A study was conducted to distinguish between the stages of chronic myeloid leukoses and lymphoid leukoses by means of the erythrocyte and hemoglobin content (EH) characteristic, the mass of circulating erythrocyte (MCE) characteristic, and a combination of the two. The study shows that the combined use of EH and MCE characteristics can better distinguish between the stages of chronic leukoses than by considering each of the characteristics separately. The hypothesis that the EH and MCE characteristics carry to a certain degree different information about the erythrocytes was confirmed. Moreover, the MCE characteristic provides a considerable amount of information which is applicable to the determination of the clinical severity of chronic leukoses. The measurement of the information contained in each characteristic and in their combination was made by using methods of mathematical statistics and cybernetics. R.N.A.

N67-13470# Michigan Univ., Ann Arbor. Dept. of Radiology.

CURRENT AND FUTURE NEEDS FOR REMOTE SENSOR DATA IN MEDICINE

Walter M. Whitehouse *In its* Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 55–61 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Applications of remote sensor radiant energy spectra to medical subspecialty fields are reviewed. The current and future needs for the evaluation of sensor data are discussed under the dichotomy: the spontaneously emitted infrared radiation from the patient, and the transmission or reflection by anatomic structures of ultra sound from a source placed close to the patient. Clinical thermography, or the recording of the infrared emissions from the skin of human subjects, in the following areas of practical interest are discussed: mammography, peripheral vascular disease, intracranial disease, obstretical problems, trauma and inflammatory disease, and basic research. Thermogram relevance, and ionizing radiation in the investigation of obstretrical problems are briefly noted. R.U.

N67-13491# Agricultural Research Service, Weslaco, Tex. Southern Plains Branch.

FACTORS AFFECTING LIGHT REFLECTANCE OF COTTON

James R. Thomas, Victor I. Myers, M. D. Heilman, and C. L. Wiegand *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 305–312 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Field and greenhouse experiments were conducted to determine the effects of plant height, percentage of ground cover, and soil salinity on the spectral characteristics of cotton. Comparison of Ektachrome infrared and black-and-white infrared photographs indicated that salt-affected cotton could be detected earlier in the season with the Ektachrome infrared film. Density of both film types was significantly correlated with plant height, percentage of ground cover, and salinity. The degree of correlation changed as the crop matured, and with the type of filter used in measuring the film density. Reflectance of individual leaves was affected by leaf age, moisture content, nitrogen fertilization, and salinity. An increase in the total moisture content or relative turgidity of the leaf significantly decreased infrared reflectance, while salt increased reflectance. Author

N67-13559# European Organization for Nuclear Research, Geneva (Switzerland).

EXPERIENCE WITH A LINEAR ENERGY TRANSFER (LET) CHAMBER AT CERN

T. R. Overton 24 Oct. 1966 42 p refs (CERN-66-33)

Basic theoretical ideas in conjunction with the physical characteristics of chamber response are portrayed in this document, which is intended to serve as a guide for future users of the linear energy transfer (LET) chambers. General ideas of the LET chamber are described, and technical details are given on path length distribution and dose measurements. The measurement of the LET-dose spectra is considered to be an important addition to the available methods for radiological protection, although the complexity of the method precludes its general application. Previous studies in this field are briefly outlined, and the design, operation, performance optimization, and practical improvements listed. Some emphasis is placed on diameters of 1–2 μ (~chromosome dimensions), and the spectra were taken at TE gas pressures which simulated approximately this size of unit density sphere. R.U.

N67-13638# Atomic Energy Commission, Idaho Falls, Idaho. Health and Safety Div.

DOSE TO VARIOUS BODY ORGANS FROM INHALATION OR INGESTION OF SOLUBLE RADIONUCLIDES

D. F. Bunch Aug. 1966 28 p refs (IDO-12054) CFSTI: $2.00

The International Commission on Radiological Protection has published two reports that provide biological data on the retention of various radionuclides in the body. These data were used to compile a list of dose conversion factors so that rapid approximations of dose from inhalation or ingestion of soluble radioactive materials may be made. Included are tables of rem per curie inhaled, rem per curie-sec/m^3 (time integrated concentration), rem percurie in the organ of interest, and rem per curie ingested. In addition, the parameters and values used to derive these factors are presented and discussed. Author (NSA)

N67-13638# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

DESIGN OF A SHIELDED SOURCE FOR THE IRRADIATION OF NATURAL ANIMAL POPULATIONS

A. C. Luces, Z. G. Burson, and R. E. Lagerquist Oak Ridge, Tenn., AEC, Feb. 1966 44 p refs

(CEX-63.10) CFSTI: $1.00

This report discusses the design of a radiation source and shield that provides dose rates in the range 0.38 to 0.75 R/hr over a 20-acre circular plot. Calculations of the primary and secondary radiations contributing to the dose distribution at the soil surface were utilized in predicting the amount of shielding necessary to provide a uniform dose rate. The source is placed on a 50-foot tower in the center of the irradiation site. A manually operated winch is used to raise and lower the source.

Author (NSA)

N67-13651# California Univ., Davis. School of Veterinary Medicine.

RADIOBIOLOGY LABORATORY Annual Report, Fiscal Year 1966

Jun. 1966 69 p refs

(Contract AT(04-3)-472)

(UCD-472-113) CFSTI: HC $3.00/MF $0.75

Summary reports are given on various topics in the fields of X-irradiation effects and radionuclide toxicity. Subjects covered include historical introduction, clinical observations, reproductive ability, survival, and pathological findings in X-irradiated beagles; historical development of radionuclide toxicity studies; clinical observations are colony status of dogs administered strontium 90 and radium 226; hematological changes in beagles administered strontium 90 and radium 226; skeletal dosimetry of beagles fed strontium 90; vitamin retention in prepared dog food as influenced by storage time; and preliminary studies on lithium fluoride radiation dosimetry. L.E.W.

N67-13652# Atomic Energy Commission, Idaho Falls, Idaho. Health and Safety Div.

CONTROLLED ENVIRONMENTAL RADIOIODINE TESTS Progress Report

D. F. Bunch ed. Aug. 1966 39 p refs

(IDO-12053; PR-2) CFSTI: HC $2.00/MF $0.50

The Controlled Environmental Radioiodine Test (CERT) program consists of a series of field releases of various types of radioiodine over different vegetation and under various meteorological conditions to obtain data on the hazard of iodine and on the quantitative movement of iodine through the air–vegetation–cow–milk–human chain. Results of the sixth and seventh tests in the series and laboratory experiments to support the field studies are reported. The laboratory experiments consisted of measuring the deposition and retention of the various forms of radioiodine on vegetation in an environmental chamber and the development of sampling techniques. Results of field studies using ^{131}I as tracer indicated that the deposition of methyl iodide (CH_3I) on grass is at least a factor of 100 less than I_2 (iodine vapor) under similar conditions and that the dose potential (defined as the ratio of standard-man ingestion dose to inhalation dose) is at least a factor of 400 less. The metabolic behavior of CH_3I in humans appeared to be very similar to other chemical forms of iodine. Information was obtained on the movement of radioiodine under typical late-fall or early-winter conditions. An analytical model was derived which makes possible rapid and reasonably accurate assessment of levels of ^{131}I activity in milk as well as the expected thyroid dose. The dose potential was evaluated as a function of season and age groups, and it is estimated that the probable ingestion dose to children under typical adverse weather conditions is about 400 times that for the standard-man inhalation dose. Results indicated that iodine concentrations in milk may be relatively greater in fall than in spring or summer months, probably due to an increased rate of secretion of iodine in milk. NSA

N67-13658# Atomic Energy Commission, New York. Health and Safety Lab.

FALLOUT PROGRAM Quarterly Summary Report, 1 Mar.–1 Jun. 1966

Edward P. Hardy, Jr. and Joseph Rivera 1 Jul. 1966 523 p refs

(HASL-172) CFSTI: HC $8.00/MF $2.25

Current data are presented from the HASL Fallout Program, Environmental Science Services Administration, National Radiation Laboratory in New Zealand, Argonne National Laboratory, and the EURATOM Joint Nuclear Research Center. Radionuclide levels in fallout, milk, tap water, diet, surface, and high-altitude air, are given in tabular form. The initial section includes interpretive reports and data summaries covering the following topics: strontium-90 concentrations in the waters of Lake Michigan and a comparison with the cumulative land deposit; a summary of the air filter samples collected during 1965 at balloon-borne altitudes; the results of an experiment to determine how much fallout debris is collected on the balloon-borne filtering devices during ascent and descent; stratospheric strontium-90 concentrations from January 1963 and predictions to August 1968; plutonium-238 in the stratosphere from SNAP-9A; vertical profiles of particulate radioactivity in the atmosphere during February 1965; gross gamma measurements in surface air from July 1965 to February 1966; global deposit of strontium-90 through 1965 and prediction for 1966; monthly averages of strontium-90 fallout and precipitation by 10° bands of latitude; and strontium-90 in human vertebrae sampled in 1965. A bibliography of recent publications related to radionuclide studies is included. Author (NSA)

N67-13673*# New York Medical Coll., N. Y.

HISTOPATHOLOGY OF THE CHIMPANZEE EAR Final Technical Report, 1 Mar. 1964–31 Dec. 1965

E. L. House, M. E. Jacobs, B. Pansky et al Holloman AFB, N. Mex., Aeromed. Res. Lab., Jun. 1966 107 p refs

(NASA Order R-25; Contract AF 29(600)-4563; Proj. 6892)

(NASA-CR-80719; ARL-TR-66-15) CFSTI: HC $4.00/MF $0.75

CSCL 06S

Four female and two male chimpanzees were secured in various positions on a Daisy Decelerator and subjected to forces ranging from 54 to 180 G. It was found that forces in excess of 54 G may rupture the tympanic membranes and cause subepithelial hemorrhages in the middle ear. The majority of cases showed proteinaceous material, with or without cells in the petrous air spaces. Discussed are the effects on the pericarotid venous plexus, the superior and posterior semicircular canals, the cupulae of the cristae ampullaris, the hair processes, the otolithic membranes, the saccule, the lumina of the vestibular apparatus, and the cochlear ducts. Although there seems to be considerable individual variation in ability to withstand these forces, neither age, sex nor weight appear to directly influence the results. The possible sources for the materials found both in the air cells and labyrinth are discussed. Author

N67-13676*# Ohio State Univ. Research Foundation, Columbus, Ohio. Dept. of Medicine.

THE EFFECTS OF GANGLIONIC AND ADRENERGIC BLOCKADE ON THE CIRCULATION OF THE YOUNG CHIMPANZEE Final Technical Report, 1 Oct. 1963–30 Apr. 1965

Clyde D. Schoenfeld, Arnold M. Weissler, Vernon L. Carter, and James V. Warren Holloman AFB, N. Mex., Aeromed. Res. Lab., Mar. 1966 23 p refs
(NASA Order R-25; Contract AF 29(600)-4385; Proj. 6892)
(NASA-CR-80716; ARL-TR-66-7) CFSTI: HC $1.00/MF $0.50 CSCL 06P

The role of the autonomic nervous system in circulatory control in young chimpanzees was evaluated through the use of selected autonomic blocking agents. Ganglionic blockade resulted in decreases in cardiac output, heart rate and arterial pressure. Beta adrenergic blockade resulted in similar decreases in cardiac output and heart rate, while arterial pressure was unchanged. Alpha adrenergic blockade caused a decrease in arterial pressure and peripheral resistance; heart rate rose and cardiac output showed no consistent change. These changes indicate that a significant amount of sympathetic-adrenergic stimulation of the circulation is present in the young resting chimpanzee. When compared to data obtained in resting humans, qualitatively similar changes are found for cardiac output and arterial pressure. It is suggested that in the chimpanzee an effective autoregulatory mechanism for control of arterial resistance exists, independent of the autonomic or adrenergic systems. Author

N67-13734# Vanderbilt Univ., Nashville, Tenn.
GLYCIDIC ESTERS AND/OR ORGANIC DISULFIDES AND RELATED SUBSTANCES, AS SOURCES OF ANTIRADIATION DRUGS Interim Research Report, 1 Oct.–31 Dec. 1965
J. D. Buckman, R. B. Barbee, M. Bellas, P. R. Engelhardt, and P. M. Giles et al [1966] 29 p refs
(Contract DA-49-193-MD-2030)
(AD-630199) CFSTI: HC $2.00/MF $0.50

Research continued on cyclic disulfides and their oxidation products and on used of the latter for synthesis of antiradiation drugs. Syntheses were continued of compounds of the type n-$C_{10}H_{21}$ NH $(CH_2)2$ SS $(CH_2)n$ X.HCl. Investigation has begun of compounds of the structure RR'C (OH) S $(CH_2)2$ NH_3 (+)Cl (−). A number of studies were made of the compound p-$C_7H_7SO_2N$=C $(SK)_2$. Reaction of thiolsulfonates with dithio acids proved unpromising for synthesis of structures of the form RC (S)SSR. Disproportionation studies of a number of carbonyl and thiocarbamoyl disulfides were completed and correlations were drawn with structural features. Research was initiated on the use of sulfonyl sulfides $(RSO_2–Sx–SO_2R)$ for preparing antiradiation drugs. Synthetic work directed toward preparation of 2,5 bis-(2-aminoethyldithio)-1, 4-benzenedicarboxylic acid, a bis analog of the active drug o-(2-aminoethyldithio)benzoic acid (VU26), was continued. TAB

N67-13780# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SECOND GROUP SPACE FLIGHT, AND CERTAIN RESULTS OF FLIGHTS OF SOVIET COSMONAUTS ON THE "VOSTOK" SHIPS
A. D. Voskresenskiy, O. G. Gazenko, and D. G. Maksimov comp. 18 Aug. 1965 197 p refs Transl. into ENGLISH of the book "Vtoroy Gruppovoy Kosmicheskiy Polet i Nekotoryye Itogi Poletov Sovetskikh Kosmonavtov Na Korabyakh "Vostok" Moscow, Izd. Nauka, 1965 p 1–228
(FTD-MT-65-256; TT-65-62984; AD-619384) CFSTI: HC $5.00/MF $1.25

Contents: General conditions of flight and flight assignment; Physiological–hygienic appraisal of the life-support systems and safety measures; Air regeneration and conditioning in the cabins of ship-satellites; Hygienic appraisal of clothes donned under pressure suit; Feeding and water supply; Medical control of physical preparation of cosmonauts; Investigation with creation of brief weightlessness on an aircraft; Investigations on a centrifuge; Investigation of vestibular reactions; Influence of high temperatures; Psychological investigations in conditions of isolation; Working activity of the cosmonauts; Results of investigations in Flight; Postflight Medical Inspection of Cosmonauts. TAB

N67-13790*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF IONIZING RADIATION ON THE FUNCTIONING OF THE VESTIBULAR ANALYZER [VLIYANIYE IONIZIRUYUSHCHEGO IZLUCHENIYA NA FUNKTSIYU VESTIBULYARNOGO ANALIZATORA]
N. V. Moskovskaya Dec. 1966 7 p refs Transl. into ENGLISH from Otorinolarigol. (Moscow), v. 21, 1960 p 59–62
(NASA-TT-F-10498) CFSTI: HC $1.00/MF $0.50 CSCL 06R

Studies on the function of the vestibular analyzer in patients subjected to the action of ionizing radiation are presented. Ionizing radiation increases the excitability of the function of the vestibular analyzer during the institution of radiation therapy, as well as after a lapse of 5–7 years following such therapy. The elevated functional excitability of the vestibular analyzer is apparently due to weakening of the inhibitory action of the cerebral cortex, which is substantiated by chloral hydrate tests. Author

N67-13806# Joint Publications Research Service, Washington, D. C.
EFFECT OF HIGH AND LOW AFFERENTATION ON HUMAN ORGANISM FROM VIEWPOINT OF SPACE PSYCHOPHYSIOLOGY
F. D. Gorbov, F. P. Kosmolinskiy, and V. I. Myasnikov 13 Dec. 1966 8 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), No. 5, 1966 p 67–71
(JPRS-39077; TT-66-35500) CFSTI: $1.00

Studied was the training of the body loop, the man–spacecraft loop, and the man–spacecraft–environment loop on the basis of flight tests, centrifugal experiments, and special simulator experiments. Information excess experiments, simulating various forms of communication with an intruding noise level close to that of the useful signal, were compared with results obtained from sensory deprivation experiments. Psychophysiological analysis of data obtained during refuelling operations showed a marked neural-emotional stress in the pilot under conditions of information overload and sensory deprivation. Optimal work, rest periods, and special motor activity schedules were recommended for astronaut conditioning on long duration flights; in addition, an intake of vitamins was proposed to increase their general physiological tone and to reduce neural stress under sensory overload conditions. G.G.

N67-13807# Joint Publications Research Service, Washington, D. C.
THE EFFECTS OF COMBINED SPACE FLIGHT FACTORS ON SOME BODILY FUNCTIONS
G. M. Frank, N. N. Livshits, M. A. Arsen'yeva, Z. I. Apanasenko, L. A. Belyayeva et al 16 Dec. 1966 26 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 5, Sep. 1966 p 625–642
(JPRS-39159; TT-66-35582) CFSTI: $1.00

Examined were the effects of acceleration, vibration, ionizing radiation, and the combined action of dynamic and radiation factors on some functions and the oxidative metabolism of the central nervous system and on mitosis in hematopoietic tissues. (1) Acceleration changed cerebral circulation markedly as a result of the interaction of mechanical and physiological factors; however, the resistance of cerebral circulation was increased by training. (2) Vibration intensified the oxidative metabolism and inhibited various divisions of the nervous system; (3) Combined acceleration and vibration effects reduced mitotic activity in bone marrow cells for 30 days; (4) Ionizing radiation and the investigated dynamic factors combined had an unidirectional effect on the oxidative metabolism in brain tissues and on mitosis in the hematopoietic system. Changes in CNS functions were complex and varied for sometime after exposure to a combination of factors. G.G.

N67-13808# Joint Publications Research Service, Washington, D. C.
STUDIES ON THE MUTAGENIC ACTIVITY OF A NEW GROUP OF CHEMICAL COMPOUNDS AND THEIR GENETIC EFFECT WHEN COMBINED WITH IONIZING RADIATION
L. A. Suykova 16 Dec. 1966 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 5, Sep. 1966 p 739–743
(JPRS-39158; TT-66-35581) CFSTI: $1.00

Mutagenic effects of the alkylating compounds K_{32}, C_{32}, K_{16}, and ethylenimine on the second generation (M_2) of barley were studied by using chlorophyll mutation as criterion. These compounds were β-bis-chlorethyl or ethylenimine derivatives which have shown antitumor activity on ascitic carcinoma cells. Air dried barley seeds were exposed to gamma rays of a Co^{60} source as well as treated in solutions of the above mutagens (pH 7.5) for 24 hours. Variation of the experiment involved radiation and treatment combining a chemical mutagen and irradiation. Results showed that the alkylating compounds are active mutagens and suitable for plant selection; the most active, K_{32}, produced 16 to 42% changed seeds of wide mutation spectrum. The combined action of chemical mutagens and radiation did not produce a distinct summational effect. G.G.

N67-13835*# National Aeronautics and Space Administration, Washington, D. C.
COMPARATIVE ANALYSIS OF THE EFFECT OF GRAVITATIONAL STRESS AND HYPOXIA ON OXYGEN TENSION IN BRAIN TISSUES [SRAVNITEL'NYY ANALIZ VLIYANIYA GIPERVESOMOSTI I GIPOKSII NA NAPRYAZHENIYE KISLORODA V TKANYAKH MOZGA]
B. M. Savin Sep. 1966 11 p refs Transl. into ENGLISH from Patol. Fiziol. i Obshchaya Patol. (USSR), v. 61, 1966 p 19–23
(NASA-TT-F-10288) CFSTI: HC $1.00/MF $0.50 CSCL 06S

It is sufficiently known from literature, that g-forces cause marked shifts in the functional state of the central nervous system, usually associated with the phenomena of acute hypoxia caused by disorders of cerebral circulation. Here, the authors came to the opinion, that hypoxia is one of the factors in the pathogenesis of disorders caused by accelerations. For experimental purposes, rabbits and cats were exposed to various gravitational stresses and the pO_2 was measured. The results are given. Author

N67-13839*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE ENZYMATIC SYNTHESIS OF POLYADENINE IN COACERVATES [IZUCHENIYE FERMENTATIVNOGO SENTEZA POLIADENINA V KOATSERVATAKH]
K. B. Serebrovskaya Dec. 1966 6 p refs Transl. into ENGLISH from the book "Problemy Evolyutsionnoy i Tekhnicheskoy Biokhimii" 1964 p 127–130
(NASA-TT-F-10440) CFSTI: HC $1.00/MF $0.50 CSCL 06A

This article investigates the spontaneous formation of coacervate droplets from high-molecular compounds, and their conversion into continuous systems. The experiments confirm A. I. Oparin's hypothesis that polymers of proteins and nucleic acids synthesized in the primeval ocean could not remain in solution, and separated out in the form of coacervate droplets. Author

N67-13840*# National Aeronautics and Space Administration, Washington, D. C.
A STUDY OF THE NEED OF TWO SPECIES OF *DUNALIELLA* ALGAE FOR MINERAL AND ORGANIC COMPONENTS OF THE MEDIUM [IZUCHENIYE POTREBNOSTI DVUKH VIDOV VODOROSLEY *DUNALIELLA* V MINERAL'NYKH I ORGANICHESKIKH KOMPONENTAKH SREDY]
Ye. S. Mil'ko Dec. 1966 11 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. Vi: Biol. Pochvoved. (Moskow), v. 1, 1962 p 18–24
(NASA-TT-F-10455) CFSTI: HC $1.00/MF $0.50 CSCL 06C

The optimal concentrations of salts found in the medium for *D. saline* and *D. viridis* were: NaCl=60 g/liter; $NaNO_3$=0.5–1 g/liter; K_2HPO_4=0.02–0.25 g/liter; $FeC_6H_5O_7\ 3H_2O$=10 mg/liter. Passing air with 5% CO_2 through the medium increases the algae yield by a factor of 2. In 10 days, with the addition of various organic substances in not one of the 35 variants was there a growth of algae in the dark. In the case of an acidic pH of the medium with the addition of glucose, acetic and pyruvic acids and ethyl alcohol, there was no increase in the yield of *D. salina* and *D. viridis* in the light or their growth in the darkness. Thus, in all the experiments, *D. salina* and *D. viridis* behave as strictly photoautotropic algae. Author

N67-13841* Yale Univ., New Haven, Conn.
[DETERMINATION AND ANALYSIS OF THE PROPERTIES AND CHARACTERISTICS OF EXTREMELY SMALL FREE-LIVING SELF-REPLICATING CELLS] Status Report, 1 Feb.–1 Aug. 1966
1 Aug. 1966 29 p refs
(Grant NsG-208)
(NASA-CR-80765) CFSTI: HC $2.00/MF $0.50 CSCL 06C

Progress is reported from an extensive examination of the thermodynamic limitations underlying the living processes. The purpose of the study is to present evidence for the general thesis that the flow of energy through a system acts to organize that system. Based on energy flow research in simple model systems, it is demonstrated that the evolution of molecular order follows from known principles of physics and does not require the introduction of new laws. Consideration is given to certain aspects of biology in terms of the concepts of thermodynamics, statistical mechanics, and the kinetic theory which lead to a closer relation between biology and physics. A.G.O.

N67-13867# Douglas Aircraft Co., Inc., Santa Monica, Calif.
THE EFFECTS OF MINIMAL DEHYDRATION UPON HUMAN TOLERANCE TO POSITIVE ACCELERATION
E. H. Taliaferro, R. R. Wempen, and W. J. White Oct. 1964 15 p refs
(Douglas Paper-3114)

The responses of three groups of human subjects to positive acceleration after undergoing minimal dehydration and heat stress are presented. A decrease in acceleration tolerance of 15% to 18% is noted. It was determined that the effects of heat stress alone did not produce the observed decrease. The possible underlying mechanisms producing these effects are discussed, and recommendations are made for future studies. Author

N67-13876*# Battelle Memorial Inst., Columbus, Ohio.
THE CULTIVATION OF HYDROGEN-FIXING BACTERIA Quarterly Status Report, 1 Jul.–30 Sep. 1966
J. F. Foster 25 Oct. 1966 13 p
(Contract NASr-100(03))
(NASA-CR-80769; QSR-14) CFSTI: HC $1.00/MF $0.50 CSCL 06M

Tentative interpretations are presented of the experimental results from six runs in the continuous-culture apparatus, in which the organism, *Hydrogenomonas eutropha*, was grown under a controlled environment for periods of 3 to 5 days in each run. It is reported that the results show growth rates much higher than had been previously observed with this organism, and it is noted that the initial growth period is critical in determining the course of the active growth in denser cultures that are produced later. The change in mode of growth is identified by a sharp pH minimum, followed by a rapid rise. Presumably, this is caused by release of ammonia as an extracellular decomposition product from urea. A.G.O.

N67-13902# Illinois Univ., Urbana. Group Effectiveness Research Lab.
TOWARD AN ANALYSIS OF THE COMPONENTS OF INTERPERSONAL ATTITUDES

Harry C. Triandis Jul. 1966 51 p refs
(Contract Nonr-1834(36); ARPA Order 454)
(TR-35; AD-638177) CFSTI: HC $3.00/MF $0.50

The paper presents evidence that interpersonal attitudes are multidimensional. In addition to the distinctions between the affective, cognitive and behavioral component, it is shown that these components themselves are multidimensional. A number of studies dealing with the dimensionality of the behavioral component are reviewed. Operational procedures for the measurement of each of the components and sub-components are presented. The stability of such measurements across different samples of social stimuli obtained from samples of individuals from several cultures is reviewed. The relationships between the characteristics of individuals and responses to the various components and subcomponents of attitudes are reviewed. Finally, a theory is presented which relates the individual's attitudes to his behavior. Author (TAB)

N67-13904 George Washington Univ., Washington, D. C. Human Resources Research Office.
A TENTATIVE ORGANIZATIONAL SCHEMA FOR DECISION-MAKING PROBLEMS
William C. Osborn and Barbara Ettinger Goodman Jul. 1966 26 p refs *Its* Exploratory Study 12
(Contract DA-44-188-ARO-2)
(HUMRRO-TR-66-14; AD-638724) CFSTI: HC $2.00/MF $0.50

To take into account the psychological complexity of most real-life decision problems, and to develop a tentative organization of decision behavior that will embrace the many, highly diverse types of problems which are presumed to result in 'decision,' an attempt was made to delineate the component response processes that lead to these decisions. The procedure followed was (a) to identify and descriptively define the relevant stimulus and organismic factors, and (b) especially to schematize the response dimensions involved, in such a way as to derive a tentative response matrix. The result is an organizational schema for use in analyzing the response aspects of the decision-making process in terms of the pertinent psychological dimensions of decision behavior. Author (TAB)

N67-13906# Goteborg Univ. (Sweden).
THE INFLUENCE OF THROMBOCYTE AGGREGATION ON RENAL CIRCULATION. AN EXPERIMENTAL STUDY IN THE CAT
Lars O. Hansson 1965 23 p refs
(Contract AF 61(052)-732)
(AD-636694)

Changes in renal blood flow during local perfusion hypothermia with cooled autologous blood, and after experimentally induced thrombocyte aggregation during normothermia, have been analysed in the cat. Perfusion cooling of the kidney to 20°C caused a two- to threefold increase in renal vascular resistance in most cases. However, in one-fourth of the animals investigated perfusion cooling provoked an extreme increase in flow resistance, eventually causing a complete renal blood flow obstruction at temperatures below 30°C. Most of these animals showed signs of infections of various kinds. The cold-induced increase in vascular resistance, whether moderate or extreme, could not be ascribed to any renal vasoconstriction, since the renal vessels were found to relax on cooling below 30°–28°C and to be largely insensitive to constrictor influences at temperature around 20°C. Cooling of the blood induced a significant drop in thrombocyte counts and when a complete renal blood flow obstruction ensued, the small renal vessels were occluded by aggregated thrombocytes. This was especially easily demonstrated in the glomerular capillaries. In these cases flushing with warm cellfree perfusates readily rinsed the renal vascular bed free of the aggregates if performed within 15–20 minutes after the complete obstruction occurred; after that period the obstruction became irreversible. Author (TAB)

N67-13911# Pennsylvania Univ., Philadelphia.
CHARACTERIZATION AND CLASSIFICATION OF CHOICE EXPERIMENTS
Robert R. Bush, Eugene Galanter, and R. Duncan Luce [1960] 45 p refs
(Contract Nonr-551(37); Grants NSF G-8864; NSF G-17637; NSF G-14839)
(AD-638218) CFSTI: HC $2.00/MF $0.50

An outcome structure is used as a model for the classification of learning and psychophysical experiments, and summaries are presented of identification and non-identification experiments that can be categorized as nonasymptotic or asymptotic. It is the study of how preferences among outcomes are to be characterized, or so-called gambling experiments that are associated with theoretical studies of the notion of utility, that are difficult to classify. The tables presented indicate a pattern of omissions, and that there are no standard psychological experiments that can be classified as optional or ambiguous identification. This represents either a serious gap in experimentation or an area in which there is little interest. A complementary relation is shown between the non-empty cells in the asymptotic and nonasymptotic rows. It appears that standard designs in learning are non-existent in psychophysics, and vice versa. It is concluded that a single theory should predict both learning and asymptotic behavior, and that further investigation is required. M.W.R.

N67-13956# Leiden Univ. (Netherlands).
MOLECULAR AND RADIATION GENETICS Annual Report, 1965
1966 24 p refs
(EURATOM-052-64-1 BIAN)
(EUR-2983.e) CFSTI: HC $1.00/MF $0.50

Structural and functional effects of ionizing radiation upon various types of DNA under a variety of conditions are discussed, as well as promising and far reaching test systems. Extensive investigations are made of the mechanism of induction of mutations in Drosophila by ionizing radiation with an emphasis on processes involved in post-radiation repair. Extension of the work to cover mechanisms of enzyme action and their modification by irradiation and effects in cultured mammalian cells is under way. Author

N67-14035*# Oak Ridge National Lab., Tenn.
SYNERGISTIC EFFECT OF ZERO-G AND RADIATION ON WHITE BLOOD CELLS. AN EXPERIMENT FOR THE GEMINI III MANNED SPACE FLIGHT Annual Report, Period Ending 30 Jun. 1965
M. A. Bender Aug. 1966 43 p refs
(NASA Order R-104; Contract W-7405-ENG-26)
(NASA-CR-80821; ORNL-TM-1550) CFSTI: HC $2.00/MF $0.50
CSCL 06R

The design and execution of an experiment on the synergistic effect of zero-G and radiation on white blood cells, which was successfully carried out during the Gemini III manned space flight of March 23, 1965, are described. The experiment consisted of the irradiation of samples of human leukocytes with ^{32}P beta particles during the orbital phase of the mission, and the subsequent cytogenetic analysis of the material to determine chromosomal aberration rates. Preparation of the experiment included the design, fabrication, and testing of the necessary hardware and equipment. The experimental data showed that although there was no significant difference between the yields of multiple-break chromosome aberrations induced on the ground and induced during orbital flight, the frequency of single-break aberrations was significantly higher in the flight samples. Several lines of evidence rule out the possibility that this difference arose from differences in absorbed dose, temperature, oxygen tension, or other parameters known to influence chromosome aberration yields. That the space flight itself induced aberrations is ruled out by the experiment control samples and also by preflight and postflight blood samples

obtained from the Gemini III flight crew. A synergism between radiation and some space-flight parameter thus appears to exist for human chromosome aberration production. NSA

N67-14042# Brookhaven National Lab., Upton, N. Y. Biology Dept.
INTERPRETATION OF MICROBEAM EXPERIMENTS FOR MANNED SPACE FLIGHT
Howard J. Curtis 1965 15 p refs Presented at the Workshop Conf. on Space Radiation Biol., Berkeley, Calif.
(Contract AT(30-2)-GEN-16)
(BNL-9468; CONF-650924-1) CFSTI: HC $1.00/MF $0.50

Previously reported work with a deuteron microbeam, which simulates the biological action of heavy particles, has shown 1) that the brain is very insensitive to this type of radiation, 2) that the epithelial cells of the lens of the eye are quite sensitive, but it takes more than a very few abnormal cells to form a cataract and 3) the hair follicles are quite sensitive, and a relatively small dose will cause the hair from an irradiated follicle to turn gray. These results are quite in accord with modern concepts in radiobiology which have been deduced from many different kinds of experiments. From these considerations one can estimate the effect of these particles on other organs of the body. It is then possible to predict with considerable confidence from the known fluxes that the heavy cosmic ray particles will not constitute an appreciable hazard for space flights of some months duration. Author (NSA)

N67-14130# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
CHARACTERIZATION OF Y-12 URANIUM PROCESS MATERIALS CORRELATED WITH IN VIVO EXPERIENCE
L. M. Steckel and C. M. West 28 Jul. 1966 44 p refs
(Contract W-7405-ENG-26)
(Y-1544-A) CFSTI: HC $3.00/MF $0.50

Twenty-two process materials from the Y-12 enriched uranium area were selected as suspect exposure materials to five employees showing internal chest burdens with long biological half lives. As a means of establishing which of these were the most likely exposure materials, measures were made of their solubility in a simulated lung fluid; each was characterized as to particle size, uranium composition, and other contaminants. Similar analyses were made on oxides prepared at known temperatures to further study the insolubility parameters. The studies indicated that three process combustion ashes, containing uranium octoxide (U_3O_8), were the most likely exposure materials. These materials apparently differed from those used in previous animal studies in thermal history, particle size, and level of contamination. In view of these differences and the paucity of such animal data, it was recommended that animal experiments be conducted using these three ashes. Author (NSA)

N67-14148# Joint Publications Research Service, Washington, D. C.
MEDICAL AND BIOLOGICAL PROBLEMS OF SPACEFLIGHTS. SPACE BIOLOGY AND MEDICINE
V. I. Yazdovskiy 2 Dec. 1966 630 p refs Transl. into ENGLISH of the book "Kosmicheskaya Biologiya i Meditsina. Mediko-Biologicheskiye Problemy Kosmicheskikh Poletov" Moscow, Nauka, Publishing House, 1966 462 p
(JPRS-38935; TT-66-35359) CFSTI: $9.30

Various aspects of the problems involved in manned space flight are considered in relation to space biology and medicine. Extensive details are given on the following topics: the nature and structure of the universe, interplanetary trajectories, methods of space research, fundamental problems of space biology and medicine, developmental stages of space biology in the U.S.S.R., impact and nonimpact accelerations, weightlessness, cosmic radiation and its biological effects, methods of medical and biological investigations during space flights, life support systems based on physical and chemical methods and on biological recirculation of substances, safety assurance in space flights, space psychology, psychophysiological capacity of astronauts relative to the control of a space craft and its systems, and specialized training of astronauts. Complete bibliographies are included with each article. L.E.W.

N67-14155# Joint Publications Research Service, Washington, D. C.
CONTEMPORARY PROBLEMS OF BIONICS AND THEIR PHILOSOPHICAL SIGNIFICANCE
E. I. Levi 12 Dec. 1966 7 p Transl. into ENGLISH from Filosofskiye Nauki (Leningrad), no. 5, 1966 p 169-172
(JPRS-39056; TT-66-35479) CFSTI: $1.00

A brief review is presented on several reports which were given at the Second All-Union Conference on Bionics; subject matter covered memory problems, mathematical models of human systems, automatic form recognition, engineering psychology, and methods for solving the problem of continuous media. Most reports were either specifically physiological or psychological. The overall successes in bionic investigations are assessed from the standpoint of the philosophical sciences. It is felt that problems will be solved on the basis of the primary positions of Marxist and Leninist philosophy, and that the conference demonstrated the worth of ideas of dialectic materialism. M.G.J.

N67-14156# Joint Publications Research Service, Washington, D. C.
EFFECT OF ACTINOMYCIN 2703 ON THE STABILIZATION OF CONDITIONED REFLEXES AND THE TRANSITION FROM SHORT-TERM TO LONG-TERM MEMORY
F. Z. Meyerson, R. I. Kruglikov, and I. A. Goryacheva 12 Dec. 1966 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 3, 1966 p 741-744
(JPRS-39060; TT-66-35483) CFSTI: $1.00

In studying the role of nucleic acid synthesis in the formation of conditioned reflexes and in mechanisms of the conditioned reflex of elementary forms of memory, investigations were made of actinomycin 2703, an inhibitor of the DNA-dependent synthesis of RNA, on current-avoiding reactions in white male mice. After the buildup of the conditioned reflex of avoidance, one group of mice was subcutaneously administered 2.5 micrograms of actinomycin daily for 5 days, and the other group received similar injections of a water-alcohol solution. It was found that relatively long subcutaneous administration of actinomycin had no substantial effect on the preservation of previously induced conditioned reflexes; however, it was also shown that subcutaneous administration of the same actinomycin doses prior to the induction of the conditioned avoidance reflex profoundly disrupted the process of its formation. Finally, experiments are described in which it was demonstrated that a small dose of actinomycin disrupts the transformation of labile, short-term memory to resistant long-term memory. L.E.W.

N67-14173# Aktiebolaget Atomenergi, Stockholm (Sweden).
DECONTAMINATION EXPERIMENTS ON INTACT PIG SKIN CONTAMINATED WITH BETA-GAMMA-EMITTING NUCLIDES
K. A. Edvardsson, S. Hagsgard, and A. Swensson Nov. 1966 38 p refs
(AE-255) CFSTI: HC $2.00/MF $0.50

Experimental results from the comparison of decontamination methods are presented. In most of the experiments NaI-131 in water solution has been utilized because this nuclide is easy to detect and relatively harmless. Among the β-γ-nuclides studied I-131 has proved to be the one most difficult to remove from the skin. Conclusions and recommendations are given which are valid primarily for iodine in the form of NaI, but are probably applicable also to many other β-γ-nuclides. A.G.O.

N67-14175*# Maryland Univ., College Park. Dept. of Botany.
CARBON DIOXIDE AND CELL DIVISION

Constantine Sorokin Repr. from Nature, v. 206, no. 4979, 3 Apr. 1965 p 35–37 refs
(Grant NsG-70)
(NASA-CR-80817) CFSTI: HC $1.00/MF $0.50 CSCL 06C

Biological investigations are reviewed in which both the promoting and inhibitory effects of carbon dioxide on cell division were recorded. In discussing the discrepancies in these results it is pointed out that there must be a separation between the effects of carbon dioxide on cell growth and cell division. A.G.O.

N67-14176*# Connecticut Univ., Storrs. Dept. of Botany.
***FASCICULOCHLORIS*, A NEW CHLOROSPHAERACEAN ALGA FROM A CONNECTICUT SOIL**
Robert J. Mc Lean and Francis R. Trainor Repr. from Phycologia, v. 4, no. 3, 1965 p 145–148 refs
(Grants NsG(T)-47; NSF GB-1856)
(NASA-CR-80818) CFSTI: HC $1.00/MF $0.50 CSCL 06M

Fasciculochloris baldii gen. et sp. nov. is described from a Connecticut cornfield soil. It is placed in the Chlorosphaeraceae (Chlorosphaerales) and distinguished from *Chlorosarcinopsis* by its zoospores, which have a wall, a pyrenoid, and flagella of unequal length. Author

N67-14180# Naval Medical Research Inst., Bethesda, Md.
ELECTROCARDIOGRAPHIC CHANGES ON RABBITS UNDER THE EFFECT OF ELEVATED ATMOSPHERIC PRESSURE [IZMENENIIA ELEKTROKARDIOGRAMMY U KROLIKOV POD VLIIANIEM POVYSHENNOGO ATMOSFERNOGO DAVLENIIA]
A. S. Solodkov 11 Jul. 1966 6 p Transl. into ENGLISH from Gigiena i Sanit. (Moscow), v. 30, no. 2, 1965 p 106–109
(NMS-TRANS-1125; TT-66-62155; AD-638189) CFSTI: HC $1.00/MF $0.50

Changes in the EKG of rabbits suggest a rather stable nature of metabolic distrubances in the heart, following the effect of compressed air on the animals. At the same time, observations indicate possible complete disappearance of disturbances in the myocardium provided there is a certain interval in the effect of elevated atmospheric pressure. Author (TAB)

N67-14210*# Minnesota Univ., Minneapolis.
"U" GEOLOGISTS DISCOVER EVIDENCE OF LIFE 3 BILLION YEARS AGO
Gerald Knox 23 Nov. 1966 2 p
(Grant NGR-24-005-054)
(NASA-CR-80833) CFSTI: HC $1.00/MF $0.50 CSCL 06C

A brief discussion is presented concerning a recent study conducted by a team of geologists from the University of Minnesota, the results of which offer further evidence supporting the theory that life has existed on earth for some three billion years. R.N.A.

N67-14317 Library of Congress, Washington, D. C. Aerospace Technology Div.
PHYSIOLOGICAL EXPERIMENTS WITH ANIMALS AND BIOLOGICAL STUDIES DURING GEOPHYSICAL AND ORBITAL FLIGHTS Surveys of Foreign Scientific and Technical Literature
Sally Warren 16 Sep. 1966 17 p
(ATD-66-117)

A synopsis of Soviet physiological experiments and biological studies with animals during geophysical and orbital flights is presented. Cited are experimental investigations on the physiological reactions of animals to accelerations, vibrations, noise, abnormal pressures, and sharp fluctuations of ambient temperature; and rocket experiments on the effect of weightlessness and the role of orientation reactions in space-flight respiration, heart-action, and blood pressure irregularities. Technological advances resulting from these studies such as the development of bioinstrumentation and radioelectronic equipment for recording simulated and actual flight data on the basic physiological functions of the animal and spaceship atmospheric parameters are discussed. The significance of experiments with the dog Laika aboard Sputnik II and succeeding experiments with dogs, rats, mice, fruit flies, and green plants is also discussed. Included are photographs which are presented in support of the text. S.C.W.

N67-14339# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF RADIATION SICKNESS PROPHYLAXIS AND TREATMENT
C. Zamfir, H. Herscovici, Gh. Cioba, and C. Andronie 4 Jan. 1967 15 p refs Transl. into ENGLISH from Rev. Sanit. Milit. (Bucharest), no. 6, Nov.–Dec. 1966 p 939–948
(JPRS-39391; TT-67-30042)

A discussion is given of the problems associated with protection against and treatment of radiation sickness. Treatment schedules are shown, and present methods of fighting infection, treatment with bone marrow, neuropsychic treatment, and treatment of the digestive syndrome. Some aspects associated with elimination of radioactive nuclides from the body are included. C.T.C.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N67-13399*# Advisory Group for Aerospace Research and Development, Paris (France).
PILOT BEHAVIOUR IN VTOL AIRCRAFT
G. Schweizer Oct. 1965 100 p refs Presented at the 27th Meeting of the AGARD Flight Mech. Panel, Rome, 11–12 Oct. 1966
(AGARD-521) CFSTI: HC $3.00/MF $0.75 CSCL 05H

Information about the handling qualities of new aeroplanes which are in the development stage is very important, since the control system, the autostabiliser and part of the avionics system are strongly influenced by the handling qualities of the aircraft. Since the pilot is nearly always included in the control loop for guidance and stability, it is difficult to obtain objective, quantitative information about the handling qualities. In the course of the development program many flight tests were carried out with a hovering rig to investigate the handling qualities of the aeroplane. The main aim of the flight tests was to obtain objective information in addition to the subjective opinion of the pilot. The amplitude distribution functions for control moments and the power spectra of the control deflections have proved to be important aids. Test runs, in which the expected flight conditions were simulated on a small hovering rig, were of great use. Author

N67-13423# Joint Publications Research Service, Washington, D. C.
THE BASIC PRINCIPLES IN THE DESIGN OF RECIRCULATION (REGENERATION) SYSTEMS
V. I. Yzadovskiy *In its* Rept. presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 9–16 (See N67-13421 04-04)
CFSTI: $4.00

On the basis of a preliminary assay of man's requirements with respect to food, water, oxygen, etc., and the possibility of realizing these conditions during long space flights, a proposed composition of potential links for a future biological–technical system is projected. It encompasses: man, autotrophs, heterotrophs, food link, link of utilization with chemical correction of nutritient solutions, physicochemical correction, and water regeneration. Depending on the purpose and flight trajectory, different variants of the above described biological–technical system can be utilized. G.G.

N67-13424# Joint Publications Research Service, Washington, D. C.

THE WAYS AND MEANS OF UTILIZING THE PRODUCTS OF VITAL FUNCTIONS IN SPACECRAFT CABINS

S. V. Chizhov *In its* Rept. presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 17–20 refs (See N67-13421 04-04) CFSTI: $4.00

Regeneration of substances from products of vital human functions during prolonged space flight is advocated by rationally combined physicochemical and biological processes. Functional links in the utilization system include: mineralization, regeneration of water and gases, and correction of mineral nutrition. A possibility of synthesizing foods on-board a spacecraft from human wastes is projected. G.G.

N67-13425# Joint Publications Research Service, Washington, D. C.

THE POSSIBILITY OF USING DEHYDRATED PRODUCTS AS FOOD FOR ASTRONAUTS

V. P. Bychkov, N. N. Boyko, A. G. Kasatkina, Yu. I. Kondrat'yev, and A. S. Ushakov *In its* Rept. presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 21–26 (See N67-13421 04-04) CFSTI: $4.00

Diets consisting of products dehydrated by thermal or sublimation methods were used on human subjects to test their influence on the metabolic processes of the human body. Three diets were compiled from foods listed in a table, and their weight, composition, and caloric values were determined. Experiments varied from 20 to 22 days. Assimilation data for diets consisting of dehydrated foods showed a decrease in protein and fat uptake but no change in carbohydrate assimilation. Nitrogen balance was positive throughout the tests except in younger and taller subjects. It was concluded that individual distinctions of the human organism must be considered in the preparation of diets for long durations. G.G.

N67-13427# Joint Publications Research Service, Washington, D. C.

THE AERO-IONIC COMPOSITION OF PRESSURIZED CABIN AIR AND ITS INFLUENCE ON THE HUMAN BODY

Yu. G. Nefedov, B. V. Anisimov, A. A. Veselova, S. N. Zaloguyev, V. V. Zhuravlev et al *In its* Rept. presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 32–46 refs (See N67-13421 04-04) CFSTI: $4.00

Background sanitary-chemical and physiological data on man during 20 day confinement in a space chamber were analyzed for the influence of ionized air on biological body action. Subjects were exposed to negative, positive, and also both types of aero-ions by means of radioactive Steinbock ionizers. Subjects' pulse rate dynamics showed an increase in systolic and minute volumes, acceleration of pulse wave distribution, and the appearance of arhythmia and extrasystoles during exercycle work under the influence of positive aero-ions. Prolonged ionization increased oxygen consumption at rest and produced a marked increase in energy expenditure during work. Under deionization conditions at rest, a decrease in oxygen consumption was noted while energy consumption remained the same as in the controls. Analysis of EEG data during respiration of air containing light aero-ions showed disturbances of the equilibrium, force, and lability of neural processes; negative ionization intensified the excitory process and increased its lability. Artificial deionization of the cabin air produced pronounced weakening of the inhibitory and excitory processes with a significant lability decrease of neural processes. G.G.

N67-13428# Joint Publications Research Service, Washington, D. C.

DEHUMIDIFICATION OF THE AIR IN THE SURVIVAL SYSTEMS OF PRESSURIZED CABINS

N. P. Perfil'yev, V. M. Men'shova, and V. K. Golov *In its* Rept. presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 47–50 (See N67-13421 04-04) CFSTI: $4.00

Proposed is a diffusion method for dehumidifying the air in a pressurized space cabin system for regeneration under conditions of weightlessness. Projected is the diffusion transfer of steam through a porous diaphragm into a sorbent-generator in which it is purified of carbon dioxide, noxious admixtures, and steam. The dehumidified and purified air is then fed into the lower part of the diffusion dehumidifier and finally into the cabin. Steam diffusion through the diagram creates a gradient of moisture condensation in the air streams to either side of the porous diaphragm and insures efficient dehumidification through the volumetric velocity of the air, its temperature, steam permeability, porous diaphragm area, and other parameters. G.G.

N67-13430# Joint Publications Research Service, Washington, D. C.

THE BASIC PRINCIPLES OF FORMATION OF THE ATMOSPHERE IN SPACECRAFT CABINS (PHYSIOLOGICAL ROLE OF ATMOSPHERIC PRESSURE)

A. G. Kuznetsov *In its* Rept. presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 53–64 refs (See N67-13421 04-04) CFSTI: $4.00

The biological role of nitrogen in a space cabin atmosphere and its influence on animals were discussed. Rats survived for 100 days in a pure oxygen atmosphere and produced normal offspring; morphological examination of the animals failed to reveal any signs of toxic poisoning or irritation of lung tissues. Microflora quantity in the cabin atmosphere increased five-fold when the bacterial spectrum shifted to forms of microorganisms that were more resistant and appeared in sporulated forms, aerobes, and fungi. It was concluded that a prolonged stay in a monogas oxygen atmosphere at a total pressure of 198 mm Hg did not influence the animals' life and general condition. An atmosphere where nitrogen is replaced by helium could protect organisms from decompression disorders because of the low solubility coefficient of helium. A helium atmosphere also shifts the range of thermal comfort to higher degrees and thus could eliminate some of the excessive body heat encountered in enclosed atmospheres. G.G.

N67-13432# Joint Publications Research Service, Washington, D. C.

THE POSSIBILITY OF USING THE POLYFUNCTIONAL PROPERTIES OF ZEOLITES IN THE SYSTEM OF PHYSICO-CHEMICAL REGENERATION OF AIR

V. K. Cherkasov, G. S. Ushakova, L. I. Piguzova, A. V. Davyatko, V. I. Solov'yev et al *In its* Rept. presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 77–81 (See N67-13421 04-04) CFSTI: $4.00

Air regeneration and carbon dioxide removal in a space cabin atmosphere was obtained by passing the air through treated zeolite in a successive process of sorption and catalysis. Experimental results showed that several cycles of sorption–catalysis did not change the results much; a correlation between reaction temperature and volumetric rate at a constant degree of conversion was maintained. A line diagram for a physico-chemical air regeneration system is shown that maintains a rigid temperature in the catalytic reactor by checking both processes of sorption and catalysis with the same B-zeolite. G.G.

N67-13433# Joint Publications Research Service, Washington, D. C.

SOME OF THE PHYSIOLOGICAL POSITIONS ON DEVELOPMENT OF THEORETICAL AND PRACTICAL BASES OF ASTRONAUT TRAINING FOR PROLONGED FLIGHTS

I. M. Khazen *In its* Rept. presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 82–109 refs (See N67-13421 04-04) CFSTI: $4.00

The physiological significance of altered gravitation and acceleration as specific stimuli of the neuro-glandular apparatus of the gastrointestinal tract in man was studied. An overall literature review on various acceleration experiments on man and animals as performed elsewhere is included. The author exposed animals to various types of acceleration and found disturbances in the periodic motor activity of their stomachs, a reduced secretion of gastric juice and enzymes from intestinal loops and glands, as well as changes in the permeability of the vascular wall. Observed decreases in lysozyme activity were related to a weakening of antibacterial properties of the digestive juices and to immuno-chemical changes in the body's internal environment. In man, many of the disturbances attributable to acceleration, hypoxia, or certain other extreme factors could be leveled off to a significant degree by intervals between repeated exposure to the same stimulus, through adaptation acquired in high mountain regions, and through general training. G.G.

N67-13434# Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF RESTRICTED MUSCULAR ACTIVITY OF MAN'S ENDURANCE OF PHYSICAL STRESS, ACCELERATIONS AND ORTHOSTATICS

L. I. Kakurin, R. M. Akhrem-Akhremovich, Yu. V. Vanyushina, R. A. Varbaronov, V. S. Georgiyevskiy et al *In its* Rept. presented at Soviet Conf. on Space Biol. and Med. 10 Nov. 1966 p 110–117 refs (See N67-13421 04-04) CFSTI: $4.00

Four male subjects maintained strict bed rest for 20 days before undergoing endurance tests to determine the orthostatic factors following restricted muscular activity and the influence of hypokinesia on the motor-cardiac and vasopressor components of the circulatory regulation. Exercycle loads after prolonged rest produced decreased work quantities, oxygen consumption, pulse rate acceleration, arteriovenous differences and oxygenation of the blood. Rotation on a centrifuge was also tolerated with much more difficulty than prior to the enforced inactivity and indicated disorders in the functional regulation centers of the cardiac activity. Also discovered were symptoms of decreased lability of the main neural processes. It was concluded that enforced rest and prolonged maintenance of a horizontal position for man resulted in persistent functional disorders of the locomotor area as well as in the visceral system. G.G.

N67-13618# System Research, Ltd., Richmond (England).

A CYBERNETIC MODEL OF HUMAN DATA PROCESSING

Gordon Pask Repr. from Excerpta Med., Ser. 49 Presented at the Proc. of the Intern. Union of Physiol. Sci. 22d Intern. Congr., Leiden, 1962

(Contract AF 61(052)-640; AF 61(052)-402)
(AD-636313)

A comparison is made of systems in which information flow and computation takes place, and the experimental method derived from the model is described. A hybrid system in which it is possible to make precise and testable statements about the information flow or computation that underlies the behavior of man as a whole is discussed, and the required conditions are identified. The experimental method is outlined for simple and more elaborately structured skills. Families of learning curves are plotted. It is concluded that the chief information derivable from an adaptively stabilized system is a set of numerical measurements obtained with the assurance that the relation between the subject and the experimental environment is held invariant. N.E.N.

N67-13623# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PHYSIOLOGICAL DATA TELEMETRY SYSTEM

N. C. Hoitink and N. S. Porter Jul. 1966 12 p
(Contract AT(45-1)-1830)
(BNWL-214) CFSTI: $1.00

A physiological data telemetry system, comprising both commercial and developed solid state circuits, was developed and is being used to monitor, on a continuous basis, body temperatures and heart function (ECG data) of two maintenance technicians working under high temperature conditions. The completed system includes two miniature transmitters, ECG electrodes, thermistor temperature probes, two FM receivers, a developed demodulator unit, and a dual channel recorder. Satisfactory performance is being achieved over 200 ft ranges in general field operation. Author (NSA)

N67-13650# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.

THE AIR VENTILATED SUIT: FURTHER EXPERIMENTS BY TWO DIFFERENT METHODS TO STUDY THE GAIN IN THERMAL INSULATION DUE TO AIR FLOW THROUGH THE MATERIAL

K. E. Spells and O. J. Blunt London, Flying Personnel Res. Comm., Jul. 1966 43 p refs
(FPRC-1233) CFSTI: HC $2.00/MF $0.50

Various arrangements of air-ventilated jackets, including assemblies lined with a cloth of low permeability, have been investigated. The percentage decrease in the original (unventilated) rate of heat loss produced by ventilation is used as a measure of the advantage due to the operation of the dynamic insulation effect. A method of measuring rates of heat loss has been developed which depends on observation of the rate of supply of energy to the thermostatically controlled water bath protected by the air-ventilated jacket. This method has been compared with the former (heat flow disk) method using the same jacket assemblies: its present defects have been indicated and suggestions for its improvement made. The existence of the dynamic insulation effect has been established beyond reasonable doubt. Author

N67-13817# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics Div.

EVALUATION OF AIRHOODS AND AIRBLOUSES USED AT A.E.R.E.

D. C. Stevens and J. B. Ritchie Sep. 1966 17 p refs
(AERE-R-5184) HMSO: 3s 6d

The penetration of a sodium chloride aerosol into airhoods and airblouses has been measured at various flow rates of compressed air. A flow of 5 cfm is required to ensure a protection factor of 1000 (penetration <0.1%). A direct reading prototype flow meter has been made which can be permanently inserted into the airline near the hood or blouse so that a wearer can adjust his air flow as required. Measurements are also reported of the noise levels in airhoods and blouses and simple means of reducing these have been investigated. These noise levels can be reduced by as much as 15 dB by the insertion of simple filter pads at the air inlet. Author

N67-13917*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aerospace Medical Inst.

A TORQUE MOTOR SERVOROTATOR FOR VESTIBULAR APPLICATION

W. Carroll Hixson and Jorma I. Niven Sep. 1966 18 p refs
(NASA Order R-93)
(NASA-CR-80763; NAMI-979) CFSTI: HC $1.00/MF $0.50
CSCL 06B

A novel servorotator, the Periodic Angular Rotator (PAR), has been developed for vestibular studies. A low speed, direct-coupled, DC torque motor is operated as a velocity or displacement mode power servomechanism to achieve a drive system with low acoustic noise and mechanical vibration properties, fast dynamic response characteristics, and a high degree of coupling stiffness. The device has a maximum angular velocity of 100 rpm, a maximum angular acceleration of 100 deg/sec^2 and can be programmed to produce sinusoidal angular acceleration stimuli extending to beyond 2.0 cps, an upper limit which is an order of magnitude greater than that previously available. Author

N67-14219*# Yeshiva Univ., New York.
ADAPTATION TO VISUAL AND NONVISUAL REARRANGEMENT
Sidney Weinstein, Milton Richlin, Marvin Weisinger, and Larry Fisher Washington, NASA, Jan. 1967 33 p refs
(Grant NsG-489)
(NASA-CR-663) CFSTI: HC $2.00/MF $0.50 CSCL 05H

Experiments were performed to study the role of various types of informational feedback in producing visual adaptation to visual rearrangement and to various head, eye, and arm positions. The validity of the reafference theory, which states that self-induced movement is essential in producing visual adaptation to rearrangement, was tested. These studies showed that prismatic refraction can produce visual adaptation in the absence of active movement, that informational feedback is sufficient and most probably necessary, that reafference is not necessary, and that its sufficiency may reflect the degree of informational feedback it provides. It is also believed that prism wearing may provide visual adaptational effects through such nonvisual channels as differential input from neck muscle receptors. The extrapolation of these results indicates the value of studying the role of intarmodal effects on sensation and perception in all modalities. R.N.A.

N67-14245*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CARBON DIOXIDE CONTROL FOR MANNED SPACECRAFT
Rex B. Martin *In its* Selected Papers on Environ. and Attitude Control of Manned Spacecraft Dec. 1966 p 11–20 refs (See N67-14243 04-31) CFSTI: HC $2.50/MF $0.75

A systems design analysis is made for the control of carbon dioxide during manned missions of up to 180 days. Substitution of heat-assigned desorption for vacuum desorption permits a reduction in system expendables by using increased electrical power. A net system weight reduction results with increased mission duration, and the substitution of waste heat for electrical resistive heating achieves further system weight reduction. Crossover times are given for a nonregenerative system and three systems using a regenerative sorber molecular sieve. Potential weight savings are also indicated for a regenerative system using an amino acid salt sorber. Oxygen reclamation is assumed to be feasible for missions of 100 days or more, and the amino acid sorber is considered for this use. M.W.R.

N67-14246*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WATER AND WASTE MANAGEMENT SYSTEMS
Vernon G. Collins and Robert W. Johnson *In its* Selected Papers on Environ. and Attitude Control of Manned Spacecraft Dec. 1966 p 21–30 refs (See N67-14243 04-31) CFSTI: HC $2.50/MF $0.75

Various techniques for water reclamation from man's waste products are summarized, including air evaporation, distillation by waste heat, electrodialysis, membrane permeation, multifiltration, and vacuum compression distillation. Prototype hardware for some of the more promising techniques are being evaluated in order to develop better water and waste management systems. It is noted that significant launch-weight savings can be effected through the use of certain reclamation techniques, and weight and other advantages and disadvantages of each of the systems are discussed. M.W.R.

N67-14247*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONTAMINANT COLLECTION AND IDENTIFICATION
Robert M. Bethea, Iris C. Anderson, and Robert A. Bruce *In its* Selected Papers on Environ. and Attitude Control of Manned Spacecraft Dec. 1966 p 31–41 refs (See N67-14243 04-31) CFSTI: HC $2.50/MF $0.75

The portion of the manned spacecraft contaminants problem involving contaminant collection and identification and biological effects is discussed. A specialized laboratory chromatograph for the detection and identification of permanent and low-molecular-weight gases present as trace contaminants in manned spacecraft and spacecraft simulators is described. This apparatus includes a special sampling device for use with manned simulators such as the integrated life support system test bed. The development of an inhouse integrated analytical system using combined gas chromatography, infrared spectrophotometry, and mass spectrometry techniques for contaminant identification is described. A tissue culture system for rapid screening of effects of toxic contaminants on biological systems is discussed, and some details of the operating procedures are given. Techniques of contaminant control by proper selection of materials and removal devices are presented. Author

N67-14248*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONTAMINANTS FROM MANNED SPACECRAFT SIMULATIONS
E. Eugene Mason and Charles H. Wilson *In its* Selected Papers on Environ. and Attitude Control of Manned Spacecraft Dec. 1966 p 43–52 ref (See N67-14243 04-31) CFSTI: HC $2.50/MF $0.75

Space conditions were simulated to study trace contaminants involved in nutritional and personal hygiene problems, and to test a completely enclosed life support system involving 5 men for 30 days. Except for ethyl mercaptan, the usual contaminants were identified during the first investigation; and charcoal sampling is shown to be a capable detector. First testing of the closed system aborted because of nausea and waste system malfunction, stressed the need for careful material selection, improved analytical techniques, and thorough trace contaminant appraisal. It is noted that a catalytic oxidizer designed to purify the air could, instead, produce byproducts more toxic than those originally present. A marked change in the normal bacterial floras in the noses and throats of the test subjects is reported during a second successful test, and the continuing need for more sensitive and reliable real time analytical equipment is indicated in both tests. M.W.R.

N67-14249*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTEGRATED REGENERATIVE LIFE SUPPORT SYSTEM FOR EXTENDED MISSION DURATIONS
Warren D. Hypes, Robert A. Bruce, and Franklin W. Booth *In its* Selected Papers on Environ. and Attitude Control of Manned Spacecraft Dec. 1966 p 53–65 (See N67-14243 04-31) CFSTI: HC $2.50/MF $0.75

Objective of the Integrated Life Support System (ILSS) project was to select, design, and develop a working model of a regenerative life support system capable of supporting a 4-man crew in a zero-gravity environment for a period of 1 year. Resupply at 60 to 90 day intervals was assumed. A tradeoff of all techniques of life support was made at component, subsystem, and system levels. The selected system utilizes a waste heat loop to supply process heat. An oxygen recovery loop based on regenerative carbon dioxide adsorption, hydrogen reduction of carbon dioxide, and electrolysis of water was selected. Closed-loop air evaporation was chosen to recover useful water from waste water. Vacuum-thermal dehydration with subsequent storage at cabin temperature was selected for processing solid waste products. While the development effort appears to be feasible, final assessment awaits a detailed evaluation. Author

N67-14251*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WATER-IMMERSION TECHNIQUE FOR SIMULATION OF INGRESS–EGRESS MANEUVERS UNDER CONDITIONS OF WEIGHTLESSNESS

Otto F. Trout, Jr. *In its* Selected Papers on Environ. and Attitude Control of Manned Spacecraft Dec. 1966 p 79–87 (See N67-14243 04-31) CFSTI: HC$2.50/MF$0.75

A water-immersion technique has been developed whereby a pressure-suited subject, unrestrained by connecting lines and hoses, can simulate maneuvers under conditions of weightlessness in six degrees of freedom. This simulation has been applied to a series of ingress–egress experiments; and the results of these experiments indicate that the technique has application to the study of human factors and capabilities in extravehicular space operations and to a determination of design criteria for advanced manned space vehicles and related equipment. Author

N67-14314# Federal Aviation Agency, Oklahoma City, Okla.
THE PREDOMINANT CAUSES OF CRASHES AND RECOMMENDED THERAPY
Stanley R. Mohler Apr. 1966 3 p refs
(AM-66-8)

Close scrutiny of the causes of recent general-aviation fatal crashes reveals that there is a wide discrepancy between the accident rate and the actual risk of flying. A large percentage of accidents occur through horseplay, foolishness, and lack of respect for nature. An increased awareness of the state of one's body while flying, enhanced training, and attitude inculcation can do much to lower the accident rate. Pilots should be instructed to avoid flight while suffering from emotional distress or the effects of alcohol consumption or during deteriorating weather conditions. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N67-13389# Library of Congress, Washington, D. C. Aerospace Technology Div.
CURRENT SOVIET RESEARCH IN THE FIELD OF HEAT-RESISTANT POLYMERS: POLYIMIDES, POLYOXAZOLES, AND POLY-1,3,4-OXADIAZOLES
Boris Nartsisson *In its* Foreign Sci. Bull., Vol. 2, no. 10 Oct. 1966 p 12–20 refs (See N67-13386 04-34)

The results are presented of current research on the synthesis, modification, and properties of heat-resistant polymers of the polyimide, polyoxazole, and poly-1,3,4-oxadiazole classes. Synthesis is achieved in two stages: polycondensation followed by cyclization. In the first stage, soluble polyamides or polyhydrazides are obtained, which are transformed by heating into the final, mostly insoluble stage. The method is promising with respect to improving the workability of otherwise unworkable materials with excellent "cosmic" properties. Author

N67-13408# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires de Saclay.
PLUTONIUM DETERMINATION BY ISOTOPIC DILUTION. I. APPLICATION TO THE STUDY OF IRRADIATED FUELS [DOSAGE DU PLUTONIUM PAR DILUTION ISOTOPIQUE. I. APPLICATION A L'ETUDE DES COMBUSTIBLES IRRADIES]
J. Chenquard and M. Lucas Brussels, EURATOM, Jul. 1966 30 p refs In FRENCH
(Contract EURATOM-037-13-60 RDF)
(EUR-2014.f, Vol. I; EURAEC-1159) CFSTI: HC$2.00/MF$0.50

The uranium/plutonium ratio in a fuel after irradiation can be determined by isotopic dilution with the aid of a solution containing both uranium-233 and plutonium which is rich in the 240 or 242 isotope. Descriptions are given of the measuring method, its calibration, the techniques for preparation of the solutions and the mass-spectrometry analysis. It is essential that after mixing, the isotope distribution in the system should be the same in the case of the atoms from the sample and those from the tracer. This condition gives rise to difficulties which are revealed, particularly during calibration. The use of an electronic computer enabled the analysis time to be reduced and the checking of the results to be simplified. The U/Pu ratio can be determined to within 3–4% by using a tracer rich in ^{240}Pu, or to within better than 2% with the aid of ^{242}Pu. The consumption of ^{238}U is measured by a special technique involving uranium hexafluoride analysis. The depletion is determined to $\pm 5 \times 10^{-4}$. Author

N67-13409# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires de Saclay.
PLUTONIUM DETERMINATION BY ISOTOPIC DILUTION IN IRRADIATED FUELS. II. CHEMICAL TREATMENT [DOSAGE DU PLUTONIUM PAR DILUTION ISOTOPIQUE. II. TRAITMENT CHIMIQUE]
M. Lucas Brussels, EURATOM, Jul. 1966 24 p refs In FRENCH
(Contract EURATOM-037-60-12 RDF)
(EUR-2014.f, Vol. 2; EURAEC-1158) CFSTI: HC$1.00/MF$0.50

Plutonium determination by isotopic dilution in irradiated fuels revealed the importance of the valency cycle. It was found that the kinetics of the plutonium oxidation–reduction reactions are greatly altered by the presence of an excess of uranium. Accordingly, certain changes in the operating technique were made in order to render the cycle efficient and thus improve the U/Pu separation; this also brought about an improvement in the stability of the thermo-ionic emission of the plutonium. An effort was made to minimize isotopic contamination by adopting a more rational mode of operation. The evaporations are carried out in such a way as to preclude the presence of saturating vapors inside the glove box. Using this technique, a second calibration of the T_2 tracer was effected by means of a new standard solution. It is considered that this solution, which is very carefully prepared by weighing out uranium and plutonium of known chemical purity, provides sufficient guarantees to be able to be used as a reference. The $^{233}U/^{242}Pu$ ratio of the tracer was determined with a relative precision of 0.5%. This modified method is at present being used for the analysis of fuel rods irradiated in G_3 Author

N67-13451# Joint Publications Research Service, Washington, D. C.
ADAPTIVE PROPERTIES OF ENZYMATIC REACTIONS WITH AN ENZYME-FORMING SYSTEM
Ye. Ye. Sel'kov *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 86–97 refs (See N67-13441 04-04) CFSTI: $5.00

An analysis of the statics and dynamics of a monomolecular enzyme reaction with an enzyme forming system (EFS) shows that the reaction with a t–r–s possesses adaptive properties. Using this phenomenon, it is shown that individual reactions with an EFS, as well as ramified polyenzymatic systems containing reactions with an EFS, are capable of learning and remembering for a long period in comparison with the mean time period of one generation of the training results. Based on previous works, it was possible to decipher the mechanism of genetic control over the enzyme synthesis (induction, repression). However, if the existence of a genetic induction is assumed, then this admission carries with it evidence of the existence of kinetic induction phenomena. The phenomena of kinetic induction may be regarded as an additional property of genetic induction. In some cases the concentration of the active enzyme may be changed in an adaptive manner when the EFS is repressed. Kinetic induction is concluded to be the antipode of product oppression in the same way as genetic induction is the antipode of repression. R.N.A.

N67-13557# United Kingdom Atomic Energy Authority, Wantage (England). Isotope Research Div.
IRRADIATION OF CARBON DIOXIDE CONTAINING SMALL AMOUNTS OF HYDROGEN. FORMATION OF METHANE

R. W. Hummel Sep. 1966 8 p ref
(AERE-R-5286) HMSO: 1s 9d

Carbon dioxide containing up to 10 vol.% H_2 was irradiated in sealed silica bulbs at near-atmospheric pressures and between 200 and 400°C. Methane was not detected at the 0.02 and 0.2 vol.% H_2 levels. At the 2 and 10 vol.% levels the initial G values for CH_4 were 0.025 and 0.050, respectively, and were independent of temperature. Author

N67-13563# Aktiebolaget Atomenergi, Stockholm (Sweden).
NUCLEAR CHEMISTRY Progress Report, 1965
G. Carlsson Apr. 1966 32 p refs
(AE-232) CFSTI: HC $2.00/MF $0.50

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3. EJECTION OF URANIUM ATOMS FROM UO_2 AND URANIUM METAL BY FISSION FRAGMENTS G. Nilsson p 10–13 refs (See N67-13566 04-06)

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N67-13564# Aktiebolaget Atomenergi, Stockholm (Sweden).
SEPARATION OF URANIUM FROM FISSION PRODUCTS BY FREEZING
H. T. Christensen and K. E. Holmberg *In its* Nucl. Chem. Apr. 1966 p 4–6 ref (See N67-13563 04-06) CFSTI: HC $2.00/MF $0.50

Experiments on crystallization by eutetic freezing and separation by centrifugation, in the presence of nitric acid, are briefly described. After uranyl nitrate solutions containing small amounts of another element were crystallized and separated, the solid fraction was found to be decontaminated by a factor in the range 10–30. Solubilities for nitrates of Ba, Sr, and C were determined, and examples of solubilities at high nitric acid concentrations and low temperatures are given. N.E.N.

N67-13565# Aktiebolaget Atomenergi, Stockholm (Sweden).
ISOTOPIC EFFECTS IN SALT-WATER SYSTEMS
K. E. Holmberg, M. Johansson, and H. Tollbaeck *In its* Nucl. Chem. Apr. 1966 p 7–9 (See N67-13563 04-06) CFSTI: HC $2.00/MF $0.50

The properties of salt solutions in heavy water, and the possibility of using salt solutions for enrichment of heavy water were investigated. The relative vapor pressures of H_2O and HDO over saturated salt solutions were obtained by means of Rayleigh distillation at low temperature, and the results are graphed. The phase diagrams were determined for a number of salts in D_2O, and the diagrams are presented. N.E.N.

N67-13566# Aktiebolaget Atomenergi, Stockholm (Sweden).
EJECTION OF URANIUM ATOMS FROM UO_2 AND URANIUM METAL BY FISSION FRAGMENTS
G. Nilsson *In its* Nucl. Chem. Apr. 1966 p 10–13 refs (See N67-13563 04-06) CFSTI: HC $2.00/MF $0.50

Experiments on the emission of uranium atoms from the surface of sintered disks of UO_2 and electropolished disks of uranium metal are reported. The emission was measured over the fission density range 5×10^{15}–7×10^{16} fiss/cm^3 in air at a pressure of about 5×10^{3} mm Hg, and the irradiations were also performed at different constant pressures of air, argon, and nitrogen. The results are discussed, and presented in graph form. N.E.N.

N67-13567# Aktiebolaget Atomenergi, Stockholm (Sweden).
RADIOLYTIC STUDIES OF THE HETEROGENOUS N-HEXANE/SILICA GEL SYSTEM
P. O. Kinell *In its* Nucl. Chem. Apr. 1966 p 14–17 (See N67-13563 04-06) CFSTI: HC $2.00/MF $0.50

Products formed by cobalt 60 gamma radiation were identified by gas chromatography and electron spin resonance spectroscopy. A dependence of the free radical yields on the hydrocarbon content was determined, and the temperature dependence showed the ethyl radical to be more stable than the other hydrocarbon radicals. The radicals formed at the lowest n-hexane contents are less stable than the radicals formed in the pure substance. The G-values for the various hydrocarbon products formed after irradiation were determined, and the dependence of the yields of C_{12} hydrocarbons on the amount of n-hexane are discussed. N.E.N.

N67-13568# Lund Univ. (Sweden). Inst. of Inorganic and Physical Chemistry.
SEPARATION OF METAL IONS BY INORGANIC ION EXCHANGERS
S. Ahrland *In* Aktiebolaget Atomenergi Nucl. Chem. Apr. 1966 p 18–26 refs (See N67-13563 04-06) CFSTI: HC $2.00/MF $0.50

The separation of cesium from concentrated uranyl solutions by means of partly dehydrated zirconium phosphate is described. The crystallinity of the gels was found to depend upon the method used in preparation. It was also determined that the gels consist of tiny fragments of the crystalline structure. The results of column separations are tabulated. The soption properties of zirconium silicate phosphates were also determined. Details on the procedures are given, and the results are presented in tables and graphs. It was concluded that only the phosphate groups exchange in the mixed gels. N.E.N.

N67-13626# Los Alamos Scientific Lab., N. Mex.
STUDIES ON THE FORMATION OF Pu_2O_3 IN THE SINTERING OF PuO_2
W. C. Pritchard and R. L. Nance 10 Aug. 1966 34 p refs
(Contract W-7405-ENG-36)
(LA-3493) CFSTI: $2.00

The effects of sintering atmospheres and temperatures on the composition of pellets of PuO_2 powder prepared from oxalate and peroxide methods were investigated. The effects of ball milling, binder additions, and cold compacting pressures were also studied. Metallographic examination as well as lattice constant results were correlated with conditions conducive to the formation of bcc Pu_2O_3. The consequences of Si as a sintering furnace contaminant were also noted. Author (NSA)

N67-13627# Union Carbide Nuclear Co., Tuxedo, N. Y.
ACTIVATION ANALYSIS WITH CHARGED PARTICLES
R. S. Tilbury Washington, NAS-NRC, [1965] 47 p refs
(NAS-NS-3110) CFSTI: $1.00

A review of charged-particle activation analysis is presented. Charged particles are compared and contrasted with uncharged particles for activation analysis and a brief discussion is given of the machines available for particle acceleration. Thick and thin targets are compared followed by the specific use in activation analysis of protons, deuterons, helium-3 ions, alpha particles, tritons, and recoil particles in a nuclear reactor. Author (NSA)

N67-13631# IIT Research Inst., Chicago, Ill. Technology Center.
RADIATION SYNTHESIS INVOLVING HALOGEN COMPOUNDS Final Report, May 1, 1960–Oct. 31, 1965
Paul Y. Feng 5 May 1966 76 p refs
(Contract AT(11-1)-578)
(COO-578-3-32) CFSTI: $3.00

Developments in studies on the radiation chemistry of selected fluorocarbons and the mechanism and reaction kinetics of the radioinduced fluorination process are reported. Studies on the

radiation chemistry of fluorocarbons were carried out either by using only a selected fluorocarbon as the irradiated material or by using the fluorocarbon mixed with other compounds that could react with the intermediate product by radiation. The radiation chemistry of CF_3Cl, CF_3Br, and CF_4 has been studied. The results show that despite the well-established thermal and chemical stability of the C–F bond, the radiation stability of the fluorocarbons is comparable with, though somewhat higher than, that of the hydrocarbons. Both ionic and radical intermediates are produced, and the primary G values are of the order of 2 to 3 or less. In addition, the C–F bond was found to be subject to attack by ionic intermediates, such as CF_3^-, leading to the formation of the fluorine abstraction product, CF_4. Irradiation of mixtures of the simple fluorocarbons with aromatic hydrocarbons led to the formation of aromatic fluorine compounds with G ~ 2 to 3. Both radical and ionic processes contribute to the observed reaction process. The temperature effects for these processes, however, differ and thus afford a means of controlling the course of the radioinduced fluorination reaction. NSA

N67-13633# Argonne National Lab., Ill.

AVERAGES OF INTERFEROMETRIC MEASUREMENTS OF THORIUM LINES

Athos Giacchetti May 1966 26 p refs
(Contract W-31-109-ENG-38)
(ANL-7209) CFSTI: $2.00

Interferometric measurements of thorium lines are compiled. Data on 701 lines are collected in Table I, including vacuum and air wavelengths, intensity and ion classification, average deviations, number of measurements, and deviations for each independent measurements. In Table II are 40 lines not included in Table I nor in computation of averages. NSA

N67-13637# Mound Lab., Miamisburg, Ohio.

MOUND LABORATORY QUARTERLY PROGRESS REPORT, JANUARY–MARCH, 1966

J. F. Eichelberger, G. R. Grove, and L. V. Jones 19 Aug. 1966 67 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1325) CFSTI: $3.00

Two sections are included on radioelements and analytical instrumentation. Separate abstracts were prepared for each. NSA

N67-13647# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

INFLUENCE OF THE INTERFACIAL TENSION ON THE PARTITION COEFFICIENT OF URANIUM IN THE SYSTEM. DILUENT+TETRABUTYLPYROPHOSPHATE/1M HNO_3

Jan Mikulski and Zdzislan Szeglowski Jul. 1966 12 p Submitted for Publication
(Rept.-490/C) CFSTI: HC $1.00/MF $0.50

Interfacial tension measurements were made for the extraction systems diluent+TBPP/1 M HNO_3 containing $4.9 \cdot 10^{-4}$ M of uranyl nitrate enriched with ^{235}U. It has been established that the partition coefficient of uranium attains maximum at the interfacial tension of ca 20 dynes/cm. Author

N67-13653# National Lead Co. of Ohio, Cincinnati.

THE EFFECTS OF VARIOUS GRADES OF GRAPHITE ELECTRODES ON THE CARRIER DISTILLATION OF IMPURITIES IN U_3O_8. SUPPLEMENTAL REPORT: MB-100 AND Ex-11 GRAPHITES

C. E. Pepper, C. E. Duff, and A. J. Pardi Sep. 1966 7 p refs
(Contract AT(30-1)-1156)
(NLCO-976) CFSTI: HC $1.00/MF $0.50

Two new grades of spectroscopic graphite were evaluated for use as electrodes in the determination of impurities in U_3O_8 samples. A 10% AgCl–LiF carrier-distillation technique was employed. Random samples of the test electrodes were checked for purity and conformity with specifications for electrode geometry. The sensitivities and precisions of seven elements (Al, B, Cr, Cu, Fe, Ni, and Si) were determined and compared with those obtained for reference graphite electrodes. Author (NSA)

N67-13670*# Grace (W. R.) and Co., Clarksville, Md. Research Div.

SYNTHESIS OF LINEAR, DOUBLE CHAIN, LADDER POLYMERS FROM SUBSTITUTED TETRAPHOSPHONITRILES Quarterly Report, Sep.–Nov. 1966

Bernard Grushkin, Robert M. Murch, T. S. Soddy and T. Bieniek 14 Dec. 1966 26 p
(Contract NASw-1415)
(NASA-CR-80722; QR-2) CFSTI: HC $2.00/MF $0.50 CSCL 07C

The thermal polymerization of β-*trans*-$[OPN(NH_2)]_4$ was investigated at temperatures ranging from 209° to 320°C. Highest number average molecular weight of 36,000 was obtained when the deammoniation was carried out at 265°C. The following monomers have been prepared and are now being used for polymerization studies: $[OPN(N_3)]_4$, $[OPN(NCS)]_4$ and $[OPN(NHCH_3)]_4$. Thermal deamination of the tetrakismonomethylamide resulted in lower molecular weight polymers. By heating the tetraazide, nitrogen is evolved and a polymeric material is produced. Author

N67-13712# United Kingdom Atomic Energy Authority, Wantage (England). Isotope Research Div.

A RAPID TRACER METHOD FOR THE DETERMINATION OF RADIOLYTIC CARBON DIOXIDE BY GAS COUNTING

P. R. Hills and S. W. F. Restall Sep. 1966 15 p refs
(AERE-R-5253) HMSO: 2s 6d

A method is described for estimating small amounts of carbon dioxide produced in liquid systems during the radiolysis of ^{14}C labelled compounds. Carbon dioxide is swept from the reaction vessel in a suitable gas stream, from which it is condensed and counted internally in a Geiger counter. It has been shown that the method can follow rapid changes in carbon dioxide evolution. In order to obtain absolute radiolytic yields, the activity of solutions before radiolysis is determined by a combustion flask technique, modified so that the samples are burnt in a stream of oxygen. The technique is rapid and reproducible. The conditions under which such an estimation method might be applied to the evaluation of radioactive paper chromatograms have been determined. Author

N67-13736# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

DETERMINATION OF OXYGEN CONTENT OF REFRACTORY OXIDES BY THE SULPHUR MONOCHLORIDE METHOD [DETERMINAZIONE DELL'OSSIGENO NEGLI OSSIDI REFRATTARI COL METODO AL MONOCLORURO DI ZOLFO]

G. Gigli Brussels, EURATOM, Sep. 1966 27 p refs In ITALIAN; ENGLISH summary
(EUR-3077.I) CFSTI: HC $2.00/MF $0.50

The S_2Cl_2 method has been applied to the determination of oxygen into 3 refractory oxides: ZrO_2, MgO, Al_2O_3. Utilizing the synthetized reagent freshly prepared and HgS as absorbant of S_2Cl_2 excess vapours, the results obtained have been satisfactory. Reaction temperature has been consistent at 900°C. The total standard deviation for the 3 oxides calculated over 26 determinations is ±0.90 for oxygen content between 25 and 50% and for sampling of 20–35 mg. The obtained sensitivity limit is 70 µg oxygen per hour for a flow of inert gas of 1.4 litres per hour and for temperatures of the reagent in its container, near to its B.P. This method has been applied with good results for the resolution of analytical problems presented by certain particular SAP types, with high contents of combined N, up to 2% and not readily attacked by gaseous HCl at 400°C. The method is, therefore, advantageous, because, if not a substitutive one of gaseous HCl method, it is at least a good integrative one of the same method for Al_2O_3 determination in SAP. Author

N67-13737# Institute of Modern Languages, Inc., Washington, D. C.

ELECTRONIC ABSORPTION SPECTRA AND STABILITY OF UNIFORM COMPLEXES [ELEKTRONYE SPEKTRY POGLOSHCHENIA I STABILNOST ODNOTYPNYKH COMPLECSOV]

B. O. Beresin Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Sep. 1966 17 p refs Transl. into ENGLISH from Khim. Khim. Tekhnol. (Moscow), no. 2, 1964 p 202–209
(Contract DA-44-009-AMC-1563(T7))
(T-1865-66; TT-66-62199; AD-638669) CFSTI: HC $1.00/MF $0.50

Based on examples with phthalocyanine and porphyrine, an investigation was made pertaining to the matter of type and shift of absorption bands in cyclic pi-ligands during the coordination of different metal ions. It was shown, that the shift of the first absorption band in the electronic spectrum of the pi-ligand depends not only upon the pi-bond strength, but is also a function of the type and strength (stability) of the sigma-bond; of the magnitude of central ion effective charge in the complex and of the geometric distortion factor of the ligand pi-system during the coordination. All these electronic and structural factors differently influence, on one hand, the stability of the complex, and on the other the pi-ligand electronic levels. Therefore, the spectral criterion of complex stability with organic pi-ligands in the form, which is generally accepted (the larger the hypeochromic shift, the greater the complex stability), has a very limited application. TAB

N67-13750# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

MONTMORILLONITE EXCHANGE EQUILIBRIA WITH STRONTIUM–SODIUM–CESIUM

J. R. Eliason *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol.3 May 1966 p 23–27 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

The ion exchange isotherms and the free energy changes of −2278, −331, and −4019 cal/mole for the cesium–sodium, strontium–sodium, and cesium–strontium systems respectively were determined for the Bayard, New Mexico montmorillonite. The same measurement gave −2035 cal/mole for the cesium–sodium system on the Chambers, Arizona montmorillonite. A surprising increase in selectivity for cesium and strontium at high loadings was observed in the cesium–sodium and strontium–sodium systems. The selectivity increases were presumed to be related to changes in the c-axis spacings. Author

N67-13751# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

SELF-DIFFUSION OF SODIUM IN VERMICULITE

B. F. Hajek and J. R. Eliason *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 28–30 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Particle self-diffusion coefficients of sodium were determined in a fraction of nearly pure vermiculite utilizing a thin bed technique. The size fractions were obtained by sieving and sedimentation. The self-diffusion coefficient of sodium at exchange half-time was 0.56×10^{-7} cm^2/sec. Author

N67-13752# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

EXCHANGE OF ALKALI METAL CATIONS ON A NATURAL STILBITE

L. L. Ames, Jr. *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 31–34 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Cation exchange reactions involving sodium, potassium, and cesium with a natural stilbite were investigated. Equilibrium constants of 7.03, 0.131, and 1.03 were derived from the 23°C isotherms for sodium on the zeolite replaced by cesium, potassium on the zeolite replaced by sodium, and potassium on the zeolite replaced by cesium, respectively. The equilibrium constant for sodium on the zeolite replaced by cesium falls to 1.65 at 85°C. Author

N67-13753# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

ALKALI METAL CATION EQUILIBRIA WITH CHABAZITE

L. L. Ames, Jr. *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 34–37 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Chabazite equilibria were studied in the systems sodium–potassium, sodium–cesium, and cesium–potassium at 23°C. The Gibbs free-energy change derived from the isotherm for the reaction $Na_{zeolite} + K_{solution} \rightleftharpoons K_{zeolite} + Na_{solution}$ showed good agreement with Barrer's chabazite results for the same system. Only 85% of the 3.53 sodium atoms per unit cell, or 3.00 cesium atoms, were contained in the chabazite cell at equilibrium. These equilibria can be explained in terms of the chabazite crystal structure given by Smith. Author

N67-13754# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

UNIT CELL SIZE AND CESIUM LOADING ON TYPE A AND TYPE X ZEOLITES

L. L. Ames, Jr. *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 37–39 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

A study was made to determine whether a correlation existed between cesium loading and zeolite unit cell size similar to a reported correlation between calcium loading and Type A unit cell size. The latter correlation was confirmed, but no pronounced cesium loading-unit cell size correlation was noted. The possibility exists that changes in water plus cation volume could give rise to a curve of the reflective sort. Author

N67-13755# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

CATION EXCHANGE PROPERTIES OF WAIRAKITE AND ANALCIME

L. L. Ames, Jr. *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 39–42 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Strontium and calcium based analcimes were synthesized and their cation exchange properties compared with those of natural and synthetic wairakites. Not even calcium self-exchange was exhibited by the wairakites. Strontium self-exchange was absent on calcium and strontium analcimes. Wairakite occupies a position in the analcime series analogous to pollucite. Author

N67-13756# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

RADIONUCLIDE MIGRATION IN SOIL COLUMNS. DEVELOPMENT OF A COMPUTER PROGRAM

B. F. Hajek *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 43–44 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

A method to predict radionuclide distribution and breakthrough concentrations was developed for simple soil–solution systems. Input data consist of the equilibrium distribution coefficient, weight of soil and volume of soil solution. Experimental and calculated ^{32}P breakthrough curves agreed satisfactorily with the relative breakthrough concentration of 60%. Author

N67-13757# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

DISPERSION CHARACTERISTICS OF STRONTIUM IN SOIL COLUMNS

B. F. Hajek *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 44–47 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Dispersion experiments were conducted with strontium in soil columns. A mathematical model was compared to the experimental data and was found to predict adequately the strontium distribution in soil columns. Author

N67-13758# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

CESIUM AND STRONTIUM DISTRIBUTION BENEATH LIQUID WASTE DISPOSAL SITES

J. R. Raymond *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 47–51 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Investigation was made of radiocontaminant concentrations and distribution beneath selected liquid waste disposal facilities. Additional wells were drilled and core samples taken of the earth materials for laboratory analysis. The bulk of the long-lived radioisotopes, such as ^{137}Cs and ^{90}Sr, was found retained high in the soil column some 100 ft or more above the regional water table. Thus the effectiveness of the soil in removing certain radioisotopes by absorption and ion exchange is confirmed. Author

N67-13764# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

RELEASE OF NOBLE GASES FROM AQUEOUS SOLUTION

A. K. Postma *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 68–69 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Release rate of a dissolved noble gas from a pool of water is effectively governed by the transport rate through the liquid film adjacent to the air–water interface. A theoretical study which made use of the limited available data showed that a half-time of release may vary from about 7 to over 1000 hr. for a pool 5 ft. deep. Better definition of liquid film transport coefficients through experimental studies is required to better define the release rate. Author

N67-13783*# National Aeronautics and Space Administration, Washington, D. C.

THE REACTION OF CARBON DIOXIDE AND FINELY DISPERSED CALCIUM OXIDE IN THE PRESENCE OF WATER VAPOR [VZAIMODEYSTVIYE UGLEKISLOGO GAZA S MELKODISPERSNOY OKIS'YU KAL'TSIYA V PRISUTSTVII VODYANYKH PAROV]

O. K. Davtyan, Ye. N. Ovchinnikova, and N. M. Soboleva Sep. Transl. into ENGLISH from the book "Nauchnyy Yezhgodnik, Vypusk 2" Odessa, Odesskiy Gos. Univ., 1961 p 128–129 (NASA-TT-F-10287) CFSTI: HC $1.00/MF $0.50 CSCL 07B

The reaction was studied, since it had been observed that these reactants produce a marble-like layer on surfaces. The experiments were made at temperatures of 100°, 200°, 300°, and 400°C. It was found that the most favorable temperature was between 200° and 300°C, while a higher temperature was unsuited due to the reversibility of the reaction. The result shows that fillers might have to be added to the initial CaO to avoid cracks in the final product. Author

N67-13788*# National Aeronautics and Space Administration, Washington, D. C.

THE KINETICS OF THERMAL DECOMPOSITION OF SILVER OXALATE [KINETIKA TERMICHESKOGO RASPADA OKSALATA SEREBRA]

B. V. Yerofeyev, P. I. Bel'kevich, and A. A. Volkova Nov. 1966 17 p refs Transl. into ENGLISH Zh. Fiz. Khim. (Moscow), v. 20, no. 10, 1946 p 1103–1112 (NASA-TT-F-10415) CFSTI: HC $1.00/MF $0.50 CSCL 07C

The kinetics of thermal decomposition of silver oxalate under conditions of photographic darkness was studied. The kinetic findings corroborate the idea of the reaction mechanism as a process of generation and growth of submicroscopic three-dimensional reaction nuclei. Author

N67-13821 Advisory Group for Aerospace Research and Development, Paris (France).

LOW TEMPERATURE OXIDATION

W. Jost, ed. (Gottingen Univ.) New York, Gordon and Breach Sci. Publishers, 1965 396 p refs (AGARDograph-86)

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N67-13822 Advisory Group for Aerospace Research and Development, Paris (France).

KINETIC BASIS OF OXIDATION PROCESSES

W. Jose (Gottingen Univ.) *In its* Low Temp. Oxidation 1965 p 1–35 refs (See N67-13821 04-06)

Discussed are the theoretical foundations of elementary thermodynamic reactions that are applicable to a complex oxidation reaction mechanism; considered is a formal treatment without derivation of the rate of expressions for the elementary steps involved. An example study on the oxidation rate of methyl-ethyl-ketone obtained reaction times of minutes in the 440° to 520°C region for stoichiometric mixtures under about 250 mm Hg pressure; at the time of maximum CO concentration the ratio $[CO]:[CO_2]$ was about 4. Explosive oxidation studies on 1/2 stoichiometric diethylketone air mixtures under increasing temperatures showed a steady increasing oxidation rate at a reaction time of two minutes until explosion occurred at 542°C. G.G.

N67-13823 Advisory Group for Aerospace Research and Development, Paris (France).

THE OXIDATION OF HYDROGEN

H. Richtering (Gottingen Univ.) *In its* Low Temp. Oxidation 1965 p 37–82 refs (See N67-13821 04-06)

A brief review is given on research of H_2–O_2 reactions at various temperatures up to the onset of explosion and also on explosion limits. The surprising discovery of several explosion limits at the same temperature but at different pressure levels was studied in detail for low pressure reactions below 20 mm Hg and proved the great influence that the wall geometry of the pressure vessel had on the reaction mechanism; larger vessels lowered first time explosion limits and their product of diameter times pressure was nearly constant. In general, the higher the initial temperature, the steeper was the increase of reaction velocity and the greater

its maximum. The whole region of low pressure explosion in the H_2–O_2 reaction showed a form typical of a branched chain mechanism. Additions of small amounts of an inert gas gave the mixture a higher value for the first explosion limit and extended the low pressure explosion region down to 350°C. Second limit transition points, induced either by pressure decrease or temperature increase, indicated a chain reaction in which termination as well as branching occurred during gas phase and where an increased pressure favored termination. Reaction rates between the second and third explosion limits, induced by few millimeters of pressure decrease, were strongly dependent upon the surface conditions of the pressure vessel. G.G.

N67-13824 Advisory Group for Aerospace Research and Development, Paris (France).
THE OXIDATION OF CARBON MONOXIDE
Th. Grewer (Farbwerke Hoechst AG) *In its* Low Temp. Oxidation 1965 p 83–106 refs (See N67-13821 04-06)

The oxidation of carbon monoxide is extraordinarily sensitive to the presence of small amounts of hydrogen, water vapour or other hydrogen containing compounds. The rate of reaction is well dried CO–O_2 mixtures is very slow indeed, whereas small amounts of water vapour increase it considerably. The presence of hydrogen or water also has a strong influence on the flame velocity, on the detonation and on the inflammability of CO–O_2 mixtures: an addition of 3 per cent H_2 to a dry mixture increases the laminar flame velocity from 20 to 100 cm/sec. Again, although no stable detonation can be achieved in pure CO–O_2 mixtures, moist or hydrogen containing mixtures can be easily detonated. The position of the explosion limits depends strongly on the hydrogen or water content of the mixture. Author

N67-13825 Advisory Group for Aerospace Research and Development, Paris (France).
THE OXIDATION OF CARBON DISULPHIDE
Th. Grewer (Farbwerke Hoechst AG) *In its* Low Temp. Oxidation 1965 p 107–115 refs (See N67-13821 04-06)

Gaseous CS_2 is oxidized even at comparatively low temperatures. The self-ignition temperature of CS_2 in appropriate mixtures with oxygen or air is about 100°C. As in the hydrogen–oxygen system, three explosion limits are observed. Reaction products are SO_2, CO_2, CO, COS, sulphur and other solid substances. The slow reaction outside the explosion region produces a smoke of solid reaction products, and at sufficiently high temperatures luminescence is observed. The most surprising phenomenon of CS_2 oxidation is the ability of very lean mixtures to react. Even in extremely lean mixtures flames are propagated which, because of the very small temperature increase involved, are called "cool flames". These flames are quite different from the "cool flames" of hydrocarbons which are propagated in rich mixtures. Author

N67-13826 Advisory Group for Aerospace Research and Development, Paris (France).
THE OXIDATION OF HYDROGEN SULPHIDE
Th. Grewer (Farbwerke Hoechst AG) *In its* Low Temp. Oxidation 1965 p 117–123 refs (See N67-13821 04-06)

Reviewed are several studies on the oxidation of hydrogen sulfide and the explosion limits of various H_2S–O_2 mixtures. All explosion limits showed a strong dependence on gas composition, wall materials and vessel dimensions; increased mole fraction of O_2 led to an enlarged explosion region. H_2S–O_2 mixtures, in which some reaction had already occurred, ignited more easily than fresh mixtures and exhibited a broader explosion region of intense luminosity and short induction period. The formation of S_2O_2 during slow oxidation of H_2S was attributed to a low temperature isothermal process that did not attain equilibrium. In a quasi-adiabatic reaction the formation of OH radicals occurred according to: $HS + O_2 \rightarrow SO + OH$. G.G.

N67-13827 Advisory Group for Aerospace Research and Development, Paris (France).
THE COMBUSTION OF METHANE
D. E. Hoare (St. Andrews Univ.) *In its* Low Temp. Oxidation 1965 p 125–167 refs (See N67-13821 04-06)

The oxidation of methane was studied by numerous investigators and the following intermediates were determined: methanol, formaldehyde, hydrogen, and ethane. It was established that methane oxidation depended very much on the surface material of the reaction vessel; in pyrex vessels, hydrogen peroxide formed at the same order of magnitude as the oxidation rate of methane. Surfaces acting as good catalysts for hydrogen peroxide decomposition gave slow rates of methane oxidation. The observed chemiluminescence during rapid methane combustion was attributed to radical-radical reactions. Major reaction products of methane oxidation by ozone were CO, CO_2, HCOOH, and H_2O vapor. Concentrations of spectroscopically measured reaction products for a run with ozonized oxygen at 66.6°C are shown. G.G.

N67-13828 Advisory Group for Aerospace Research and Development, Paris (France).
OXIDATION BY OXIDES OF NITROGEN AND OZONE
Th. Grewer (Farbwerke Hoechst AG) *In its* Low Temp. Oxidation 1965 p 169–190 refs (See N67-13821 04-06)

All oxidation processes involving N_2O were closely connected to the thermal decomposition of this compound. Nitrous oxide oxidation rates, decomposition products, chain mechanisms, and explosion limits were established for reactions with H_2, NH_3, CO, and various hydrocarbons. A definite difference was found between the oxidation kinetics for reactions between N_2O and CH_4 and those with higher hydrocarbons; higher hydrocarbons oxidized at 500° to 550°C by N_2O itself. Also discussed were various oxidation experiments by nitric oxide, nitrogen dioxide, and ozone. G.G.

N67-13829 Advisory Group for Aerospace Research and Development, Paris (France).
THE OXIDATION OF HYDROCARBONS
L. Sieg (Fachverbandes Kohlechemie e.V.) *In its* Low Temp. Oxidation 1965 p 191–284 refs (See N67-13821 04-06)

The literature review covers the oxidation mechanisms of the following hydrocarbons: ethane, ethylene, ethanol, acetaldehyde, propane, propylene, propenol, propionaldehyde, n-butane, isobutane, hexane, olefins, aromatic hydrocarbons, and hydrocarbon mixtures. In general, it was found that different mechanisms acted at high and low reaction temperatures and that there were characteristic differences between the products formed at different temperatures. G.G.

N67-13832 Advisory Group for Aerospace Research and Development, Paris (France).
THE PYROLYSIS OF ORGANIC COMPOUNDS
H. Formanek (Gottingen Univ.) *In its* Low Temp. Oxidation 1965 p 371–397 refs (See N67-13821 04-06)

Presented is a brief survey on selected gas phase oxidations of organic compounds together with their decomposition reactions. Nitric oxide and similar propylene or other unsaturated hydrocarbons reduced decomposition rates in general but did not influence the oxidation rates. The thermal decomposition of methane showed an apparent activation energy of 79 kcal/mole between 700°C and 850°C; ethane decomposition produced ethylene, methane and higher hydrocarbons at 650°C. Propene decomposed faster than propylene, butene and butene decomposed with the same speed, and hexene more rapidly than hexane. Paraffins with two and three carbon atoms decomposed quicker than corresponding olefins. Also reported are pyrolyses studies on ethers, alcohols, aldehydes and ketones, and peroxides. G.G.

N67-13833*# National Aeronautics and Space Administration, Washington, D. C.

CALCULATION OF THERMODYNAMIC FUNCTIONS OF CHEMICALLY REACTIVE GASES [RASCHET TERMODINAMICHESKIKH FUNKTSIY KHIMICHESKI REAGIRUYUSHCHIKH GAZOV]

V. B. Nesterenko and V. P. Bubnov Nov. 1966 15 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR, Ser. Fiz.-Tekhn. Navuk (Minsk), no. 1, 1966 p 5–14
(NASA-TT-F-10400) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Thermodynamic analysis of the dissociating system N_2O_4. The physicochemical properties of N_2O_4 are determined and the entropy and enthalpy are calculated as functions of temperature and pressure. The calculated values are shown to be sufficiently accurate for use in preliminary design of turbines, heat exchangers, and thermodynamic cycles. Author

N67-13899# Polish Academy of Sciences, Warsaw.

THE INFLUENCE OF SOME PARAMETERS ON THE CHEMICAL COMPOSITION OF THE AQUEOUS SOLUTIONS OF UNLABELLED AND P-32 LABELLED META AND PYRO PHOSPHORIC ACIDS

Krystyna Zelenay and Antoni Pasternak Jun. 1966 18 p refs
(Rept.-726/XIII/C) CFSTI: HC $1.00/MF $0.50

The dependence of chemical changes in HPO_3 and $H_4P_2O_7$ solutions in the course of time upon changes in dilution, pH, and temperature was investigated. Immediately after dilution the polymerization of ortho- to pyro- and polyforms occurs, and then after few hours the depolymerization begins, the latter being a general tendency in phosphoric acid solutions. The changes of poly- to ortho-form proceed through pyro-form. The changes are faster with greater dilution, lower pH, and higher temperature. No difference in behavior was observed between radioactive and inactive solutions. Author

N67-13918# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.

NEW MATERIALS FOR ION EXCHANGE—A LITERATURE SURVEY TO DECEMBER, 1965

R. L. Hemmings Mar. 1966 52 p refs
AECL-2546) CFSTI: HC $3.00/MF $0.50

The search for ion exchange materials for full flow demineralization of reactor feedwater at temperatures near 300°C has centered on insoluble inorganic compounds. Many of the compounds investigated are unsuitable for high temperature water purification, but exhibit unusual selectivity towards certain valuable metallic ions. Because of this, these compounds may be very useful in recovery of various components from radioactive wastes and from fuel reprocessing solutions. Most inorganic materials are little affected by even high level radiation, a property not common with organic materials. Materials which show most promise for high temperature water purifications are hydrous zirconium oxide and zirconium phosphate. Lead sulphate, magnetite and activated carbon (or charcoal) also show promise in this field. Materials containing Si or Al are, in general, unsatisfactory because of the release of these ions. The properties of the above mentioned exchange materials are not known at flow rates greater than 0.03 kg/min(cm^{2}bed) or 10 gal(US)/min(ft^2 bed). In addition, efficiencies and capacities at very low impurity concentrations are also unknown and must be investigated to allow an economic design of a high temperature ion exchange system for full flow purification of the feedwater of a boiling water reactor. Author

N67-13978# Ludwig-Maximilians-Universitat, Munich (West Germany).

CHEMISTRY OF PROMETHIUM [ZUR CHEMIE DES PROMETHIUMS]

1966 97 p refs In GERMAN
(NP-16254)

The fluoride, chloride, bromide, oxyhalides, iodate, oxides hydroxide, phosphate, arsenate, chromate, vanadate, scandate, borate, indate, tungstate, molybdate, and chromate of Pm were prepared. Pm salts of some acids were also prepared. These included the dihydrate of Pm carbonate, the decahydrate of Pm oxalate, Pm formate, and Pm trichloroacetate. X-ray diffraction patterns were obtained for all compounds prepared. The ion radius of the Pm(III) ion was determined and found to lie between that of Nd and Sm. NSA

N67-13988# California Univ., Livermore. Lawrence Radiation Lab

REACTIONS OF OXIDES AND CARBIDES WITH METALS

A. I. Avgustinik May 1966 30 p refs Transl. into ENGLISH from Zh. Vses. Khim. Obshch. (USSR), v. 10, 1965 p 512–518
(UCRL-TRANS-10044) CFSTI: HC $2.00/MF $0.50

A review of literature data and information is presented on high-temperature reactions between metals and borides, carbides, oxides, and nitrides. The information is concerned mostly with chemical reactions between ceramic refractory materials and transition metals. It is noted that the high-temperature reactions are predominantly chemical. NSA

N67-13995# Kernforschungsanlage, Juelich (West Germany). Institut fuer Radiochemie.

SEPARATION AND RADIOCHEMICAL DETERMINATION OF FISSION ELEMENT ACTIVITIES [ABTRENNUNG UND RADIOCHEMISCHE BESTIMMUNG VON SPALTELEMENTAKTIVITAETEN]

Adolf von Baeckmann, H. Schroeder, H. H. Stamm, and H. Wertenbach Dec. 1965 118 p In GERMAN Supported in Part by EURATOM
(KFK-387)

Laboratory methods for the separation of fission elements and determination of their relative activity are described. The separation of Sr, Zr, Mo, Lu, Te, I, Cs, Ba, and Ce from fission product solutions are considered, and the reproducibility of the methods used is discussed. NSA

N67-13999# Puerto Rico Nuclear Center, Mayaguez. Radioisotope Application Div.

MATRIX ISOLATION STUDIES OF PRODUCTS OF GAMMA-RADIOLYSIS OF HETEROCYCLIC MOLECULES Progress Report, Fiscal Year 1966

Alec Grimison 1966 20 p
(Contract AT(40-1)-1833)
(PRNC-88; PR-1) CFSTI: HC $1.00/MF $0.50

Two designs of optical dewars were tested for the examination of optical spectra at liquid nitrogen temperatures. Preliminary qualitative results were obtained by gamma irradiation of a wide variety of heterocyclic molecules in methyltetrahydrofuran and 3-methylpentane glassy solutions at 77°K. Color formation was examined visually. Theoretical studies were made using the valence-bond technique and the molecular-orbital technique. NSA

N67-14003# Los Alamos Scientific Lab., N. Mex.

THE SOLUBILITIES OF SELECTED ELEMENTS IN LIQUID PLUTONIUM. VIII: MOLYBDENUM

D. F. Bowersox and J. A. Leary 1 Aug. 1966 11 p refs
(Contract W-7405-ENG-36)
(LA-3523) CFSTI: HC $1.00/MF $0.50

The solubility of Mo in liquid Pu was measured over the temperature range 700 to 1000° C. The solubility increased from 0.63% Mo (by weight) at 700° C to 2.07% Mo at 1000° C. The data fit the equation $\log N_{Mo} = 0.329 - 2.06 \times 10^{-3} T^{-1}$, where N_{Mo} is the solubility expressed as the mole fraction and T is the temperature in degrees Kelvin. Author (NSA)

N67-14016# Illinois Univ., Urbana. Dept. of Physics.
ION MOBILITY IN LIQUID He^3 BELOW 1°K
Moyses Kuchnir (Ph.D. Thesis) May 1966 104 p refs
(Contract AT(11-1)-1198)
(COO-1198-364) CFSTI: HC $4.00/MF $1.00

The low field mobility of positive and negative ions in liquid ^3He was measured for temperatures between 0.03° K and 1° K and pressures of 27.9 atm, 7.5 atm, and less than 0.35 atm. Ions in the liquid were produced by a radioactive tritiated titanium source and their mobility was obtained by directly measuring their drift velocity using a time of flight technique which involved a multigrid system of electrodes. Details of the experimental procedures as well as of the experimental apparatus and its construction are given. The positive ion mobility, μ_+, was found to be larger than the negative, μ_-, except at 27.9 atm above 0.3° K, where both are ≈0.036 cm^2/V sec. By increasing the pressure, μ_- was observed to increase while μ_+ descreased. Furthermore, μ_- was found to be a continuous function of the temperature, reproducible within 1% throughout the entire temperature range of the measurements, while μ_+ presented hysteresis in a temperature range that depended on the pressure. The experimental results are presented in both graph and table forms. Some typical mobility values are given. The "cluster" model for the positive ion and the "bubble" model for the negative ion in liquid helium are discussed and applied for liquid ^3He. The temperature and pressure dependence of μ_- between 0.03° K and 0.07° K is in agreement with the theoretical prediction for the mobility of an electron localized in a bubble that undergoes Brownian motion in a Fermi gas. No theoretical calculation available predicts μ_- between 0.07° K and 1° K or μ_+ correctly.
Author (NSA)

N67-14019# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
THE DETERMINATION OF IRON AND NICKEL IN URANIUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY
G. A. Shepherd and A. J. Johnson [1966] 23 p refs Presented at the 8th Ann. Rocky Mt. Spectry. Conf., Denver, 8-9 Aug. 1966
(Contract AT(29-1)-1106)
(RFP-698; CONF-660810-3) CFSTI: HC $1.00/MF $0.50

Uranium was analyzed for iron and nickel by atomic absorption spectrophotometry. Iron and nickel were determined in the samples under three different experimental conditions: in solutions containing uranium, in solutions extracted from uranium, and by the method of additions. The results obtained were compared. A comparison was also made of results reported by atomic absorption, emission spectrography, and colorimetric methods. The relative standard deviation for iron at 165 ppM was 6.3, 4.3, and 7.9%, respectively. Relative standard deviation for nickel at 20 ppM was 7.9, 2.8, and 36.0%, respectively. The ppM values are in terms of original uranium sample weight.
Author (NSA)

N67-14026# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
THE MICRODETERMINATION OF CARBON AND HYDROGEN IN HYDROGENATED POLYPHENYLS, FOULING FILMS, AND TERPHENYL MIXTURES
M. A. Grant and R. B. Stewart Jan. 1966 13 p refs
(AECL-2524) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

A procedure for the determination of carbon and hydrogen in hydrogenated polyphenyls, fouling films, and terphenyl mixtures based on the classical method by Pregl is described. For hydrogenated polyphenyls standard deviations of 0.08% for the hydrogen percentage and of 0.35% for the carbon percentage were found. For a mixture of terphenyl isomers standard deviations of 0.10% for the hydrogen percentage and of 0.23% for the carbon percentage were found.
Author (NSA)

N67-14032# Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
ELECTROLYTIC RECOVERY OF SCRAP URANIUM METAL
W. S. Fleming, R. D. Piper, and J. A. Kennelley 19 Aug. 1966 15 p refs
(Contract W-14-108-ENG-8)
(MCW-1494) CFSTI: HC $1.00/MF $0.50

An electrolytic process for recovery of scrap uranium metal was developed on a laboratory scale. In this process, uranium oxides on the scrap react with a consumable graphite anode to form uranium metal and carbon monoxide. Operation at 1150°C in a fused BaF_2–LiF–UF_4 electrolyte produces molten metal at the cathode by a combination of electrolytic reduction of the oxides, electrolytic transfer of the metal, and thermal melting of the metal. Scrap type, cell design, electrolyte composition, and cathode current density were found to be major factors affecting current efficiency and metal quality.
Author (NSA)

N67-14036# Kernforschungsanlage, Juelich (West Germany). Institut fuer Radiochemie.
DOUBLE FLUORIDES OF TETRAVALENT ACTINIDE ELEMENTS THORIUM, URANIUM, NEPTUNIUM, AND PLUTONIUM OF THE TYPE $Me^{II}Me^{IV}F_6$ WITH LaF_3 STRUCTURE [UEBER DOPPELFLUORIDE DER VIERWERTIGEN ACTINIDENELEMENTE THORIUM, URAN, NEPTUNIUM UND PLUTONIUM VOM TYP $Me^{II}Me^{IV}F_6$ MIT LaF_3-STRUKTUR]
Manfred Salzer Feb. 1966 68 p refs In GERMAN Supported by EURATOM
(KFK-385)

The preparation and properties of the double fluorides of some actinide elements with the general formula $Me^{II}Me^{IV}F_6$ (where Me^{II}=Ca, Sr, Ba, Pb, Cd, Eu and Me^{IV}=Th, U, Np, and Pu) were investigated. The compounds $CaThF_6$, $CaUF_6$, $CaNpF_6$, $CaPuF_6$, $SrThF_6$, $SrUF_6$, $SrNpF_6$, $SrPuF_6$, $BaThF_6$, $BaUF_6$, $BaNpF_6$, $PbThF_6$, $PbUF_6$, $PbNpF_6$, $CdThF_6$, and $EuThF_6$ were prepared by solid state reactions in the temperature interval from 800° to 1,100° C. The compounds $CaThF_6$, $SrThF_6$, $SrUF_6$, $SrNpF_6$, $SrPuF_6$, $SrCeF_6$, $BaThF_6$, $BaUF_6$, $PbThF_6$, $PbUF_6$, $PbCeF_6$ were prepared by precipitation reactions from aqueous solutions. All the compounds prepared from aqueous solutions crystallized in the hexagonal LaF_3 lattice. The lattice constants of all compounds prepared were determined. In the framework of solubility studies on the systems MeF_6–$MeXF_6$ (Me=Ca, Sr, Ba, and Pb and X=Th, U, Np, and Pu) and MeF_2–XF_3 (Me=Ca, Sr, and Ba and X=Ce, Pu, and Am) it was found that between 25 and 27 mole % of MeF_2 dissolves in $Me^{II}Me^{IV}F_6$. A solubility of $Me^{II}Me^{IV}F_6$ in MeF_2 could be detected only in the system $BaThF_6$–BaF_2. A solubility of MeF_2 in MeF_3 could be found only in the system SrF_2–CeF_3. By density measurement it was determined that in the solubility of MeF_2 in $Me^{II}Me^{IV}F_6$ an ion vacancy is formed. The results of X-ray studies of the double fluorides are tabulated.
Author (NSA)

N67-14037# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ANALYSIS OF RADIOACTIVE METALS BY SPARK SOURCE MASS SPECTROGRAPHY
A. J. Johnson, A. Kozy, and R. N. Morris Aug. 1966 30 p refs Presented at 8th Ann. Rocky Mt. Spectry. Conf., Denver, 8-9 Aug. 1966
(Contract AT(29-1)-1106)
(REP-699; CONF-660810-1) CFSTI: HC $2.00/MF $0.50

A spark source mass spectrograph was adapted for the analysis of plutonium and americium metals. Over 70 elements can be determined in these metals on the same analysis. Elements such as Cl, F, S, Ta, W, and rare earths, which require involved procedures for determination by emission spectrographic or chemical methods, can be readily determined by mass spectrography. A comparison was made between results obtained by mass

spectroscopy and by conventional methods for impurity elements. The operations involved in handling radioactive materials in the mass spectrograph are also discussed. Author (NSA)

N67-14038# Kentucky Univ., Lexington. Dept. of Chemistry.
THE DETERMINATION OF BROMINE IN TERRESTRIAL AND EXTRATERRESTRIAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS
Kenneth W. Lieberman (Ph.D. Thesis) 1 Jul. 1966 179 p refs
(Contract AT(40-1)-2670)
(ORO-2670-13) CFSTI: HC $5.00/MF $1.00

The geochemical behavior of Br in terrestrial and extraterrestrial materials was investigated. A method was developed to accurately determine Br in a silicate matrix for abundance levels of 1 ppM or less, using neutron activation. Irradiated samples were dissolved in a Na_2O_2–NaOH fusion mixture and Br was separated by treatment with a series of selective oxidizing and reducing agents in conjunction with a solvent extraction procedure. Analytical determinations for Br were conducted on specimens from the major chondrite and achondrite classifications, australites and other tektites, igneous rocks from the Palisades Sill and the Oslo plutonic sequence, specimens from other intrusive and extrusive igneous formations, eight standard rocks, some possible upper mantle materials, and on two deep-sea sediment cores. Br was found to be fractionated among the three major chondrite groups; carbonaceous, enstatite, and ordinary. It becomes progressively depleted in going from carbonaceous to the ordinary chondrites. Br was depleted during fractionation of a magma in the formation of the Oslo plutonic sequence, and was enriched during the fractionation of the Palisades magma. The geochemical behavior of Br during differentiation of the Palisades Sill is comparable to the behavior of F in the Great Lake Sheet. The abundance of Br in igneous rocks was relatively uniform and for the majority of analyses ranged from 0.15–1.5 ppM. The Br abundance data for the australites suggest a geographical trend with generally higher concentrations in the east and a progressive depletion toward the west. Br was enriched in the deep-sea sediments investigated with respect to oceanic water. NSA

N67-14039# Yeshiva Univ., New York. Belfer Graduate School of Science.
STABLE ISOTOPE STUDIES Annual Progress Report, 15 Jul. 1965–15 Aug. 1966
William Spindel 15 Aug. 1966 67 p refs
(Contract AT(30-1)-3462)
(NYO-3462-2) CFSTI: HC $3.00/MF $0.75

Experimental results are reported on the fractionation factor for nitrogen-15 between nitric oxide and nitric acid solutions at various temperatures below room temperature. Additional reactivity of nitric oxide with the acid solutions at lower temperature appears to limit the magnitude of the fractionation factor. Partition function ratios for nitrogen and oxygen exchange were calculated over a wide range of temperatures for about 14 different inorganic oxy-nitrogen molecules from the best available spectroscopic data. Partition function ratios calculated by approximation methods were compared to results obtained by an exact equation. Equilibrium constants for both N and O exchange among all the molecules were calculated and a large number of instances of inversion of isotope fractionation was found, including several cases of multiple inversions. Further studies are in progress on the inversions of isotope effect and the relationship between isotope effects and individual interatomic motions in the molecules. Author (NSA)

N67-14063# Wuerzberg Univ. (West Germany). Inst. of Physical Chemistry.
ELECTROLYTIC DEPOSITION OF BERYLLIUM FROM METALLORGANIC COMPLEX-SALTS [ELEKTROLYTISCHE ABSCHEIDUNG VON BERYLLIUM AUS METALLORGANISCHEN KOMPLEXSALZEN]
May 1966 14 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-66-10)

The electrodeposition of beryllium as a coherent film is possible from beryllium organic complex-salts of the type $MX\text{-}n\text{-}Be(C_2H_5)_2$ in the temperature range from 60 to 100°C on copper or silver electrodes. The exact analysis of the deposited beryllium showed, however, that, simultaneously at the cathode, Be_2C is formed, which becomes immersed in the beryllium deposit. The amount of Be_2C in Be is about 20 to 30%. Author (NSA)

N67-14083# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
URANIUM METAL BY CARBON REDUCTION OF URANIUM OXIDE IN VACUUM
H. A. Wilhelm, R. V. Strain, and E. P. Neubauer 14 Jun. 1966 37 p refs Presented at the Vacuum Met. Conf., New York, 27–29 Jun. 1966 *Its* AMES Lab. Contrib. No. 1910
(Contract W-7405-ENG-42)
(IS-1379; CONF-660630-1) CFSTI: HC $2.00/MF $0.50

In the reduction of uranium oxides by C under vacuum conditions below 1000°C, it appears that any higher uranium oxide is reduced to the dioxide. The reduction of UO_2 to form carbide takes place at 1300 to 1500°C. Lower oxides are formed at temperatures up to around 1800°C. The final stage of the reaction is between UC and residual oxide and requires temperatures between 1900 and about 2100°C. A container for the charge and primary metal product at the highest temperatures is of major concern. Slip-cast Y_2O_3 crucibles have been used in this capacity for studying the reduction and preparing primary metal for subsequent treatments. UO_2 can be reduced by C in a vacuum to give at least 90% yield of primary metal containing about 0.25% C. Most of this C precipitates in the form of UC dendrites as the liquid metal cools to its solidification temperature. Granulation or fragmentation of the dendrites followed by segregation of the UC by liquation permits recovery of a major part of the primary metal with relatively low C content. Author (NSA)

N67-14117# Royal Aircraft Establishment, Farnborough (England).
A STUDY OF COHESIVE FORCES, REFRACTIVE INDICES AND GLASS TRANSITION TEMPERATURE DATA OF POLYMERS
J. H. Sewell Jun. 1966 21 p refs
(RAE-TR-66185) CFSTI: HC $1.00/MF $0.50

There is a linear relationship between the molar refraction, R, and the sum of the molar-attraction constants, $\sqrt{(EV)}$, both for liquids and polymers. It follows that cohesive energy density, E/V, is directly proportional to the refractive index function, $(n^2 - 1/n^2 + 2)^2$. It is shown and found that for two non-polar rubbers, swelling tends to increase as the refractive index of a solvent approaches that of a rubber, but maximum swelling occurs at a lower refractive index than predicted. As expected, swelling data for polar rubbers and solvents do not follow the predicted trend. No relationship is found between glass temperature (T_G) and refractive index for polymers having T_G's below 298° K because of divergences in data from relationships involving cohesive energy density and T_G, and between R and $\sqrt{(EV)}$. Author

N67-14215*# National Bureau of Standards, Washington, D. C.
A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Ninth Preliminary Report, 1 Jul.–30 Sep. 1966
George T. Furukawa, Martin L. Reilly, G. D. Mitchell, E. S. Domalski, I. Halow et al 1 Nov. 1966 145 p refs
(NASA Order R-138)
(NASA-CR-80828; NBS-9449) CFSTI: HC $4.00/MF $1.00
CSCL 07C

Analytical data are presented on the vaporization and vapor pressure measurements of 13 alpha-amino acids, and changes in

thermodynamic quantities on sublimation at 455°K are listed. A literature survey was also conducted on measurements reported for values of benzene, naphthalene, antracene, and phenanthrene; the bibliography is included. Extensive tabular data are presented on the thermodynamic functions for 19 amino acids plus furan and urea, and for 98 inorganic and a few simple organic compounds. M.G.J.

N67-14309# English Electric Co., Ltd., Whetstone (England). Aircraft Equipment Div.
PHOSPHONITRILIC FLUOROALKOXIDE POLYMERS
M. V. Lenton Min. of Aviation, Sep. 1966 48 p refs Prepared for Dir. of Mater. Res. and Deve.lop.
(KS/1/0161/CB.43(a)2)
(D-MAT-139) CFSTI: HC $2.00/MF $0.50

A series of fluoroalkoxy substituted trimeric phosphonitrile ring compounds has been prepared. Attempts to polymerise the hexa(fluoroalkoxy)triphosphonitriles failed. Unsymmetrical substituted derivatives containing two different fluoroalkoxy groups have been evaluated as high temperature fluid materials. Substitution of fluoroalkoxy groups into phosphonitrilic chloride rubbery high polymer has yielded hydrolytically stable elastomers of poor thermal stability, in which considerable cross-linking is postulated. The preparation and properties of some fluoroalkyl phosphites and chlorophosphites are described. Phosphonitrile polymer formation from these materials by reaction with alkali metal azides proved impossible. Attempts to prepare bis(fluoroalkoxy) trichlorophosphoranes failed to yield the required materials. All attempts at the partial replacement of the chlorine atoms in phosphonitrilic chloride trimer, by fluoroalkoxy groups, gave complex isomer mixtures of varying degrees of substitution from which pure materials could not be separated. A series of diamino tetrakis(fluoroalkoxy)triphosphonitriles has been prepared, and the condensation polymerisation with fluorinated dihydroxy alcohols studied. The products of the condensation are in some cases elastomeric, and may lead towards a new type of potentially useful rubbery material. Author (ERSO)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N67-13489# National Center for Atmospheric Research, Boulder, Colo.
THE REMOTE SENSING OF RADIO EMISSION FROM CONVECTIVE CLOUDS
J. Doyne Sartor *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 285-292 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Narrow band slices have been taken of the radio emission spectrum from convective clouds in the frequency range from 30 mc to 550 mc together with a 7.5 kc receiver to monitor long and short range lightning discharges. Despite the careful choice of the bands to avoid interference from man-made sources, a major problem is the identification of spurious noise. In spite of these interferences radiation apparently associated with growing convective clouds has been observed from an aircraft. The number of discharges per km^2 per sec observed at the different frequencies is a function of receiver sensitivity, suggesting that "atmospherics" vary greatly in spectral intensity. The number of discharges observed generally exceeds previous estimates. It is concluded that highly directional ground-based antennas with supporting airborne measurements of cloud parameters would be superior to a completely airborne system. Author

N67-13512# Kansas Univ., Lawrence.
SOME EMPIRICAL AND THEORETICAL INTERPRETATIONS OF MULTIPLE POLARIZATION RADAR DATA
Robert D. Ellermeier, A. K. Fung, and David S. Simonett *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 657-670 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50
(Contract NSR-17-004-003; Grants NsG-298; NSF GP-2259)

Recent theoretical work has shown that to a first order approximation: (a) the direct polarized backscattered radar signal is proportional to the product of the appropriate Fresnel reflection coefficient and the sum of the cosine of the angle of incidence and a slope term measured along the terrain profile in the plane of incidence; and (b) the cross polarized backscattered radar signal is proportional to the product of the sum of the two Fresnel reflection coefficients and the slope measured along the profile perpendicular to the incident plane. Thus, a measure of the surface roughness may be obtained by proper instrumentation of the direct and cross polarized components of the signal return. This development is unique in that the cross polarized as well as the direct polarized return components are explicit in the formulation. Empirical evidence supporting the theoretical study has been obtained from analysis of multiple polarization imagery using single frequency direct and cross polarized radar data. Author

N67-13545 Academy of Sciences (USSR), Moscow. Astronomical Committee.
BULLETIN OF STATIONS FOR OPTICAL SATELLITE TRACKING, NO. 43
1965 46 p refs In RUSSIAN
CFSTI: HC $2.00/MF $0.50

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6. ON THE DETERMINATION OF THE DISTORTION COEFFICIENT E. A. Yurov p 14-15 refs (See N67-13551 04-07)

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10. IN INVESTIGATION OF THE MEASURING DEVICE UIM-21 AT THE UZHGOROD UNIVERSITY A. G. Kiritchenko p 27-30 refs (See N67-13555 04-07)

11. VISUAL TRACKING AT THE SATELLITE STATION OF THE KIROV PEDAGOGICAL INSTITUTE B. I. Krasnov and E. I. Kovisin p 32-35 (See N67-13556 04-07)

N67-13546 Academy of Sciences (USSR), Moscow. Astronomical Committee.

RASTER-CAMERA FOR ARTIFICIAL SPACE BODIES PHOTOGRAPHING

G. A. Leikin *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 3–5 In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

It is shown that raster designed in a certain way and placed between the objective and photoemulsion permits enlarging considerably the limiting magnitude of photographed artificial space bodies at the cost of some lower accuracy of coordinates determination. Author

N67-13547 Academy of Sciences (USSR), Moscow. Astronomical Committee.

A DETERMINATION OF THE MAJOR SEMI-AXIS OF SATELLITE ORBIT FROM A LIMITED NUMBER OF OBSERVATIONS

A. M. Lozinsky *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 6–7 In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

The crossing time of a satellite with the plane of the geographical parallel on which the tracking station is situated coincides with the moment when it crosses the topocentric celestial Equator. This fact is used for the determination of the node period of a satellite with $(1+H/R) \sin i > \sin \phi$ from tracking data obtained by one station. Methods of such observations are given. A small number of observations permits evaluation of the major semi-axis of the satellite orbit rather precisely. Author

N67-13548 Academy of Sciences (USSR), Moscow. Astronomical Committee.

USE OF HOMOGRAPHICAL COORDINATES FOR ASTROMETRIC REDUCTION OF PHOTOGRAPHS OF ARTIFICIAL SATELLITES

A. A. Kiselev *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 7–9 In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

The possibility is considered of using homographical coordinates for the determination of photographic positions of a satellite with four reper stars when the optical center is unknown. Author

N67-13549 Academy of Sciences (USSR), Moscow. Astronomical Committee.

AN ANALYTIC METHOD FOR DETERMINATION OF THE POSITION OF THE OPTICAL CENTRE USING REPER STARS

A. A. Kiselev *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 9–13 In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

An analitic method is described for the determination of the position of the optical center of a photograph based on four reper stars. The result is obtained directly in the form of equatorial coordinates of the center. Author

N67-13550 Academy of Sciences (USSR), Moscow. Astronomical Committee.

ON THE ACCURACY OF POSITION DETERMINATION OF ARTIFICIAL SATELLITES BY PHOTOGRAPHS TAKEN WITH THE CAMERA NAFA-3c/25

A. M. Lozinsky *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 13–14 In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

The accuracy of position determination of satellites was evaluated from positions of control stars on 85 photographs obtained at the Zvenigorod Station. Author

N67-13551 Academy of Sciences (USSR), Moscow. Astronomical Committee.

ON THE DETERMINATION OF THE DISTORTION COEFFICIENT

E. A. Yurov *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 14–15 refs In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

An analytical method for obtaining the distortion coefficient is described. Author

N67-13552 Academy of Sciences (USSR), Moscow. Astronomical Committee.

ON THE TIME SERVICE AT SATELLITE TRACKING STATIONS

A. A. Logvinenko *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 16–19 refs In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

A new method is given for the determination of the delay in the impulse relay by using shortened second time signals with an artificial fore-front. The construction and the use of a sensor for the determination of the delay and for the adjustment of the chronograph during conditions of interferances are described.

N67-13553 Academy of Sciences (USSR), Moscow. Astronomical Committee.

IMPROVEMENT OF PRECISION OF TIMING FOR PHOTOGRAPHIC SATELLITE TRACKING

A. A. Logvinenko *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 19–23 refs In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

An improved chronograph is proposed for timing at satellite tracking. The chronograph is constructed on the base of a clock driving device of chronograph 21 P-22 P. A marking by photographing rotating discs with impulse lamps is proposed instead of the usual mechanical method of time marking, that has a high inertia and lacks accuracy. Author

N67-13554 Academy of Sciences (USSR), Moscow. Astronomical Committee.

INVESTIGATION OF THE FORM OF DIRECTIONAL RULERS AND OF ERRORS OF THE OCULAR MICROMETERS OF TWO MEASURING INSTRUMENTS KIM-3

A. G. Krylov and V. A. Yurevitch *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 24–27 refs In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

Results of the estimation of the form of directional rulers and of the errors of ocular micrometers of the KIM-3 measuring instruments are given. The curvature of the directional rulers increases considerably with time and amounts up to 20 on the edges. An estimation of the errors of the micrometers show that they amount up to 1 μ. Author

N67-13555 Academy of Sciences (USSR), Moscow. Astronomical Committee.

AN INVESTIGATION OF THE MEASURING DEVICE UIM-21 AT THE UZHGOROD UNIVERSITY

A. G. Kiritchenko *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 27–30 refs In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

Results of investigation of the main elements of the measuring device that introduce systematic errors into the measurements are given for spiral micrometers, correcting lines and marked scales. The angle between the leading lines is measured. The results obtained show a rather good quality of the device. Author

N67-13556 Academy of Sciences (USSR), Moscow. Astronomical Committee.

VISUAL TRACKING AT THE SATELLITE STATION OF THE KIROV PEDAGOGICAL INSTITUTE

B. I. Krasnov and E. I. Koviazin *In its* Bull. of Sta. for Opt. Satellite Tracking, No. 43 1965 p 32–35 In RUSSIAN; ENGLISH summary (See N67-13545 04-07) CFSTI: HC $2.00/MF $0.50

The organization of visual tracking at a satellite station attached to the Pedagogical Institute is described. One possible way of equipping a laboratory and an observation site is proposed. Author

N67-13598*# Michigan Univ., Ann Arbor. Office of Research Administration.

RESEARCH PROGRESS Semiannual Status Report, Apr. 1–Sep. 30, 1966

14 Dec. 1966 5 p *Its* Rept.-02905-17-p

(Grant NsG-2-59)

(NASA-CR-80677) CFSTI: HC $1.00/MF $0.50 CSCL 09D

Research on the theory and applications of stationary point processes has continued. Cited are published theoretical studies on stationary processes, impulse processes, and information and control. Results of a study of random impulse processes are summarized. Research on optimum PCM demodulators was completed and a complete report on the use of statistical dependence between data samples in binary PCM demodulation is being prepared. Results show that in typical cases, by the use of practical techniques, the received signal strength requirements for PCM can be reduced to six decibels below those of bit-by-bit demodulators presently used. An abstract of this research is also included. Research on improved analog demodulation is in the exploratory stage. A theory designed to determine the number of achievable communication rates in environments where the signal is distorted by influences which cannot reasonably be regarded as probabilistic in nature, is under investigation. Results of a thesis on an empirical Bayes procedure and its application to communication theory are summarized. S.C.W.

N67-13613# General Dynamics/Electronics, Rochester, N. Y.

TACAN TEST SIGNAL SET AND DME TEST SIGNAL SET, PHASE I Final Report

F. Mimken and V. Hazners Nov. 1966 47 p

(Contract FA65-WA-1343)

(RD-66-84)

The feasibility test models, to make ground checks of airborne interrogator units prior to flight, are described. The sets are designed to provide a coverage of up to three miles, and have the same traffic handling capability as a DME or TACAN ground beacon. The test sets contain all solid state devices with the exception of the two rf power amplifier tubes. A self-test indicates if the test set is functioning properly, and the sets have plug-in modular construction and a small number of adjustments for easy maintainability. Important performance features are considered to be the range and bearing accuracies. N.E.N.

N67-13644# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

RECEPTION ANTENNA OF A LABORATORY OF WEIGHTLESSNESS [ANTENNE DE RECEPTION DU LABORATOIRE D'IMPESANTEUR]

Guy Ringenbach 1966 20 p refs In FRENCH Presented at 12th AGARD Electron. Group Symp. "Antennas for Airplanes and Space Vehicles", Duesseldorf, 7–13 Jul. 1966

(TP-374(1966)) CFSTI: HC $1.00/MF $0.50

A solution to the problem of radioelectric liaison of the weightlessness laboratory is presented, along with a description of the radio receiver. Experimental material was placed in a capsule and dropped in a metal tube under vacuum conditions. The use of a surface wave guide to capture the signal and guide it to the receiver in the tube is described. The mean stationary wave ratio was about 2% when the signals were telemetered throughout the fall. Transl. by R. Li.

N67-13675*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

AN EMPIRICAL BAYES TECHNIQUE IN COMMUNICATION THEORY

Stuart C. Schwartz (Ph.D. Thesis) Oct. 1966 231 p refs

(Grant NsG-2-59; ORA Proj. 02905)

(NASA-CR-80717; Rept.-02905-16-T) CFSTI: HC $8.00/MF $1.25 CSCL 09D

The communication problem is one in which a sequence of information-bearing signals is either assumed to be a stationary random process or distorted by a stationary random process. In either case, the underlying probability structure is unknown. The message sequence is then added to correlated gaussian noise. The statistical inference problem is to extract information from each member of the observation sequence, *i.e.*, make a decision as to the presence of a particular signal. The empirical Bayes procedure uses past observations to obtain consistent estimates of the unknown distributions or related quantities. These estimates are then used to form a sequence of test functions which is evaluated using only the present observation. The sequence of test functions converges to the test function one would use if all distributions were known and if the observations were independent. For a minimum probability of error criterion, the resulting difference in error probabilities is dominated by a quantity proportional to the mean-square error in the estimate of the test function. Author

N67-13689# Radio Corp. of America, Moorestown, N. J.

EFFECTS ON RADAR OF PLASMA PRODUCED BY HIGH ALTITUDE NUCLEAR DETONATION

Karl Sittel *In its* Plasma Phys. Res. and Eng. 1966 p 41–45 refs (See N67-13681 04-25)

The various forms of artificial plasmas encountered subsequent to a high altitude nuclear explosion are discussed, with consideration given to the specific electromagnetic wave propagation phenomena through the affected atmosphere. The plasma regions of interest produced by such detonations are identified as (1) increased ionization in the D-layer; (2) highly ionized beta particle ionization regions; (3) the fireball; and (4) ionized debris regions and artificial radiation belts produced by the detonation. Each is discussed in detail. It is concluded that the absorption and refraction caused by the quasi-uniform burst plasma such as the D region enhancement can be predicted fairly well, as can the generations of these ionizations regions by a burst. The point is made that radar system degradation by these combined phenomena should be seriously considered in all future designs of military systems. M.G.I.

N67-13701# Joint Publications Research Service, Washington, D. C.

TOWER ANTENNA STRUCTURES

Georgiy Adol'fovich Savitskiy 29 Nov. 1966 187 p refs Transl. into ENGLISH from the book "Antenno-Machtovyye Sooruzheniya" Moscow, State Publishing House for Lit. o Probl. of Commun. and Radio, 1962 p 1–70; 98–230

(JPRS-38865; TT-66-35289) CFSTI: $5.00

Basic problems in the construction and operation of tower antenna structures for radio communications, radio broadcasting, and television are covered in a textbook written for use at communications technical schools. Wood, ferrous and nonferrous metals, metallic parts, steel and other cables, and various materials are described. Other subjects covered are antennas, transmission lines and switches; radio towers; construction and assembly operations; and the operation of tower-type antenna structures. Safety techniques and equipment are considered for the tower-type antennas. M.W.R.

N67-13738# California Inst. of Tech., Pasadena. Antenna Lab.

A STUDY OF CROSS POLARIZATION EFFECTS IN PARABOLOIDAL ANTENNAS

Vassilios Kerdemelidis May 1966 98 p refs
(Contract AF 49(638)-1266)
(TR-36; AD-634153)

The induced surface current method is used to investigate the spatial structure of the radiated electric field for a number of paraboloidal antennas. The paraboloids are excited by three different types of feeds, namely, a small electric dipole, an elemental plane wave source, and a rectangular horn. For the case of electric dipole excitation, formulas are derived that show the following characteristics: (i) For a reflector of constant ratio of focal length to the aperture diameter the magnitude of the cross-polarized lobe nearest to the antenna axis (paraboloid axis) remains constant relative to the maxium of the main lobe of the principally-polarized wave and is independent of the aperture size. (ii) For a given aperture size the magnitude of the cross-polarized component relative to its own principally-polarized maximum decreases with the focal length. (iii) The position of the maximum of the cross-polarized lobe depends only on the aperture size and is independent of the focal length. For a paraboloid excited by an elemental Huygens source the cross-polarization in the forward direction is reduced but the component in the laterally-directed radiation is increased relative to that of an electric dipole. In the case of the horn-excited paraboloid a formula is obtained that explaines the experimentally-observed large cross-polarization. Finally, it is shown that the problems of the paraboloids excited by a small electric dipole and a plane (Huygens) source are merely particular cases of the horn excitation problem. Author (TAB)

N67-13769# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, (Brunswick).
SOME FUNDAMENTAL FEATURES OF THE TIME-DIVISION MULTIPLEX EQUIPMENT [EINIGE GRUNDSATZLICHE EIGENSCHAFTERN VON ZEITMULTIPLEXEINRICHTUNGEN]
P. Schulz Jul. 1966 25 p refs *In* GERMAN; ENGLISH summary
(DLR-MITT-66-13) CFSTI: HC$1.00/MF$0.50

In telemetry time-division multiplexing devices two amplitude modulated pulse trains occur, the sampled data function and the staircase function. Their characteristics are described in general form for any bandlimited periodic signal. The amplitude distortion of the hold circuit which causes a 36% error at the Nyquist rate is outlined as a result especially important for the user of time division multiplex equipment. Author

N67-13781*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVOLUTION OF SATELLITE PFM ENCODING SYSTEMS FROM 1960 TO 1965
Hosea D. White, Jr. Washington, NASA, Dec. 1966 18 p refs Presented at 3d Space Congr., Cocoa Beach, Fla., Mar. 1966
(NASA-TN-D-3757) CFSTI: HC$1.00/MF$0.50 CSCL 09F

The PFM encoding system was expanded to encompass more spacecraft electronics in a central package and to incorporate hardware to permit much of the time correction and error detection to be done by computer programming on the ground. The functional complexity of the encoding system is shown to have increased by a factor of 20 from Explorer XII (designed in 1960) to IMP F (designed in 1965); yet the volume has remained about the same, and low power (about 1.2 watts) has been maintained. The Explorer XII encoder took about 200 transistors, and IMP F (Super IMP) would take about 4000 if conventional circuits were used. The circuit design approaches taken in Super IMP are analyzed; and the use of a completely different approach, using MOSFET blocks, is discussed. This approach has resulted in an impressive decrease in electrical parts could and an even more impressive decrease in the dangerous nonresistor parts count. Author

N67-13914# Philco Corp., Blue Bell, Pa.
SYNTHETIC SPEECH STUDY. Final Report, 1 Jul. 1965–30 Jun. 1966
J. Bogusz, R. Smith, and G. Strohmeyer. Ft. Monmouth, N. J., Army Electron. Command, Jun. 1966 251 p refs
(Contract DA-02-086-AMC-0300(E))
(ECOM-0300-E-F; AD-639864) CFSTI: HC $6.00/MF $1.25

The report describes a technique to automatically evaluate the intelligibility of speech transmitted over a communication channel. The technique is called corodim (correlation of the recognition of degradation with intelligibility measurements). It transmits a test signal composed of speech-like sounds representative of phoneme consonants, and measures, by means of spectral channel analysis, the degradation suffered by each of the test signal constituents. The degradation manifests itself as an 'effective noise spectrum' which is measured and matched to one of a library of reference noise spectra. By means of the spectrum matching operation and a measurement of signal-to-noise ratio each constituent sound of the test signal is assigned a probability of recognition. These values are weighted by phoneme probability of occurrence factors, summed, and normalized to obtain a score representative of word intelligibility based on either initial or final consonant recognition of CVC-type words. Corodim evaluates scores for both initial and final consonants and takes their product for the overall word intelligibility score. The part of the corodim technique following the spectral analysis operation was computer simulated. Author (TAB)

N67-13921 Advisory Group for Aerospace Research and Development, Paris (France).
RADAR TECHNIQUES FOR DETECTION TRACKING AND NAVIGATION
W. T. Blackband (RAE, Farnborough (England)) New York, Gordon and Breach Sci. Publishers, Inc., 1966 Proc. of the 8th Symp. of the AGARD Avionics Panel held at London, 21–25 Sep. 1964
(AGARDograph-100) CSCL 17I

Radar systems designs are discussed, and the effect of expanding computing capabilities upon radar planning and the choice of modulation system is emphasized. Improved methods of handling data are considered, and the influence of radar installation on structural engineering is pointed out. M.G.J.

N67-13922 Compagnie Francaise Thomson-Houston, Bagneux (France).
A NEW PHILOSOPHY OF RADAR, CHAPTER 1
Michel H. Carpentier *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 1–7 (See N67-13921 04-07)

Conventional radars are based upon pulse train modulation, and they measure range in terms of pulse delay. The measurement of this may be made by the use of either correlators or matched filters. The choice of transmitter modulation is discussed. This choice should take into account the modulation effects of a scanning antenna. The receiver should be matched to the signal reflected from the target, which for large moving targets may differ appreciably from the transmitted signal. Author

N67-13923 Space Technology Labs., Inc., Redondo Beach, Calif.
PARAMETRIC ANALYSIS OF SPACEBORNE RADAR APPLICATIONS, CHAPTER 2
R. J. Orford *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 9–19 refs (See N67-13921 04-07)

The significant relationships between radar parameters and mission parameters pertaining to search and acquisition are shown. The most important of these is the linear variation of rada power-aperture product with detection range, closing velocity anc search area, and the optimization of search frame time. The linear variation with range was unexpected and indicates a tradeoff between detection range and spacecraft propulsion requirements. Curves are presented for numerical analysis of situations with Swerling Case I type targets. Analysis of other target types showed that the increased cross-section fluctuation may demand a

considerably higher signal to noise ratio based on the average cross-section. On the other hand, due to the fluctuations, the average cross-section was larger than expected so that the overall radar power-aperture product for detection might not be appreciably affected. Author

N67-13924 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ANALYSIS OF UNCOOPERATIVE RADAR TARGETS, CHAPTER 3
R. M. Goldstein *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 21–34 refs (See N67-13921 04-07)

When the received power is large enough so that there is some margin left over from the requirements of straight detection, it becomes possible to gather much information about the target. Each point of the target has two attributes that can be measured independently at the receiver: its round-trip distance (or time delay), and its velocity (or Doppler shift). This paper discusses the special modulation and detection processes which enable the target to be analyzed into these two dimensions simultaneously. Such a system was used with Venus as the target during the conjunction of 1962, and a much improved version will be in operation for the conjunction of June 1964. It is expected that this system will yield very accurate measurements of the range of Venus, as well as the rotation rate, direction of the axis of rotation, and the detection of surface features on Venus. Author

N67-13925 Royal Radar Establishment, Malvern (England).
PULSE COMPRESSION RESEARCH IN THE UNITED KINGDOM, CHAPTER 4
E. H. Boyenval *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 35–46 (See X67-13921 04-07)

Experimental transmissions have been made with alternate pulses of single frequency and with frequency modulation. These have shown the marked advantage of even a crude pulse compression system over the normal radar when clutter returns are present. The design of an experimental pulse compression system is discussed. In this a balance was struck between the number of filter frequencies in the filter bank and the number of overlapping oscillator waveforms. A distortion measuring equipment has been developed which displays amplitude and phase errors measured on a single pulse. An adjustable compensating network has been developed. Author

N67-13926 Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
STATISTICAL METHODS FOR RADIO DETECTION, CHAPTER 5 [METHODES STATISTIQUES EN RADIODETECTION]
L. Reboul *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 47–74 In FRENCH; ENGLISH summary (See N67-13921 04-07)

A theory of detection is presented which leads to a criterion for optimum detection, that is the highest probability of detection for a given false alarm rate. In this analysis the problem is divided into four parts of increasing complexity: (1) The ideal problem of detection. In this case there is the possibility of a single known target and the decision is whether the target is present or not, i.e., whether we have a known signal plus noise or noise alone. (2) The stochastic problem of detection. This is an extension of the previous case. Any one of a number of targets may be present. There is no knowledge of what is sought, the decision is between "targets" and "no targets." (3) The problem of estimation. This extends (2) to the determination of which particular target is present and to the study of its characteristics. (4) The problem of discrimination and resolution. This covers the resolution of one target from another and of a target from noise and clutter. Author

N67-13927 Aerospace Corp., El Segundo, Calif.
TARGET RESOLUTION: CAPABILITIES OF MODERN RADAR AND FUNDAMENTAL LIMITS, CHAPTER 6
A. W. Rihaczek *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 75–95 refs (See N67-13921 04-07) (Contract AF 04(695)-269)

The study starts with an interpretation of the radar uncertainty relation in its significance for target resolution, showing the role of waveform designs as a means of achieving a match between the transmitted signal and the characteristics of the target environment. This provides a framework into which the various principles of high-resolution radar are fitted. In discussing the limitations on resolution performance, it is shown that achievable target resolution depends on the characteristics of the target environment in which radar operates, the number of targets, and size of the delay-Doppler space they occupy. These findings are applied to two practical examples: (1) the ground mapping radar using the synthetic aperture principle and (2) the case of extended target "clouds" consisting of a large number of discrete scatterers. Author

N67-13928 General Electric Co., Ltd., Stanmore (England).
MEASUREMENTS OF THE REFLECTION FROM THE GROUND OF S-BAND SIGNALS, CHAPTER 7
A. R. Domville *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 97–109 (See N67-13921 04-07)

Measurements of the reflection of S-band pulse signals from various types of ground have been made at vertical incidence: the measurements were made in conditions where the return signal was beam-width-limited. The mean reflection from most ground surfaces was found to be between 5 and 15 db below, and from water to about 1 db above that from a surface scattering uniformly without loss. Most surfaces reflected primarily by scattering, but a few gave predominantly specular reflection, and in this case the amplitude of the return signal depended strongly on the shape and inclination of the surface; the extreme values of reflection were +7 and −31 db with respect to a uniform scattering surface. The standard deviation and amplitude distribution of most surfaces is nearly Rayleigh, but significant differences have been found for near specular reflectors. Over undulating country, extended and multiple peaked echoes have been observed. Author

N67-13929 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
SOME INFORMATION ON NATURE, SIZE AND VELOCITY DISTRIBUTION OF RANDOM SCATTERERS GATHERED BY A PULSE RADAR ON TWO WAVELENGTHS USING VERTICAL FIXED BEAMS, CHAPTER 8
W. Fogy *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 111–140 refs (See N67-13921 04-07)

A vertical-beaming cloud-radar was developed, operating on two wavelengths simultaneously (X- and K_a-band). The two posdetection outputs, after sampling with range gates, are digitalized and stores for several seconds on a fast running film at a rate of 7000 bits per second per channel. The information contained on the film is transformed into punched tapes and fed into a computer for calculating the two first-order-distribution-density functions, two autocorrelation functions and one cross-correlation between the two channels. On the basis of these five statistical descriptive functions an attempt is made to read out information about the nature and some statistical parameters of clouds, rain, snow by comparison with other meteorological data, especially those measured at nearly the same time by means of an aeroplane within the range-gated pulse volume under test. Some results of a series of experimental runs are presented and discussed. Author

N67-13930 Decca Radar Ltd., Isle of Wright (England).
MOVING TARGET INDICATION: A SURVEY OF DEVELOPMENTS SINCE 1948, CHAPTER 9
P. Bradsell *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 141–172 refs (See N67-13921 04-07)

The principal developments in moving target indication (MTI) theory and technique are surveyed. By 1948, the master

oscillator-power amplifier (MOPA) system and the cohostalo system were well established, and noncoherent MTI had been used in airborne radar systems. At frequencies below 1000 Mc/s, where rf power amplifiers were available, MPOA radar transmitters continued to be used, but for L- and S-band transmitters the magnetron was preferred, being a cheap compact source of rf power requiring moderate supply voltages. Because the magnetron transmits with random initial phase, MTI systems were mostly of the cohostalo type. There were striking improvements in components for these systems, and extensions to the capability of the systems following fuller understanding of the theory of MTI. These topics are discussed, followed by a look at the new generation of MTI equipment which is coming into use. R.N.A.

N67-13931 Laboratoire Central de Telecommunications, Paris (France).

SDS RADAR, SURVEILLANCE RADAR TO DETECT SOLAR MOVING OBJECTS: EXTENSION FOR DETECTION OF LOW-FLYING AIRCRAFT, CHAPTER 10 [LE RADAR SDS, RADAR DE SURVEILLANCE DESTINE A DETECTER LES OBJECTIFS MOBILES AU SOL: EXTENSION A LA DETECTION DES AVIONS VOLANT BAS]

G. van den Broek *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 173–184 *ref* In FRENCH; ENGLISH summary (See N67-13921 04-07)

An account is given of a radar designed to fulfill the following functions: (a) the detection of moving targets on the ground with a range of 30 Km for vehicles and 15 Km for a man, (b) the measurement of bearing, elevation, and distance of the target with a precision of 5 milliradians and 40 meters respectively, (c) the identification of the nature of the targets (wheeled vehicles, tracked vehicles, pedestrians singly or in groups etc.), and (d) the identification of friendly targets. The radar operates in X-band with a 40 Kw peak power, a p.r.f of 4 kc/s, and 0.25 μs pulse length. A range of 30 Km is achieved with a resolution of 20 m. The required precision of 5 milliradians is attained. The principles of the design of this radar are applicable to the design of radars for the detection of low-flying aircraft. Author

N67-13932 Royal Radar Establishment, Malvern (England).

SIDEWAYS LOOKING AIRBORNE RADAR, CHAPTER 11

J. Highcock *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 185–202 (See N67-13921 04-07)

The development of a radar system concept in which a long aerial is mounted along the side of an aircraft so that it looks at right angles to the flight path is discussed. Consideration is given to areas such as aerial configurations, vertical pattern shape, azimuth pattern, effect of spot diameter, overall resolution of radar, camera and film, radar mapping, and the yaw and roll effect on the picture. A.G.O.

N67-13933 General Electric Co., Utica, N. Y.

AIRBORNE EARLY WARNING RADAR: SOME BASIC CONSIDERATIONS, CHAPTER 12

Sol Matt *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 203–215 (See N67-13921 04-07)

Basic considerations are presented for the design of airborne early warning systems. It is emphasized that these complex systems must be carefully designed into an aircraft, and in all instances both the radar and aircraft designer must coordinate their efforts from the beginning, with the limitations imposed by hardware, state-of-the-art, and propagation phenomena. A.G.O.

N67-13937 Raufoss Ammunisjonsfabrikker (Norway).

DOPPLER SYSTEM FOR MEASURING THE FLIGHT PERFORMANCE OF SMALL ROCKETS AND LIGHT AMMUNITION, CHAPTER 16

C. O. Lund *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 267–279 (See N67-13921 04-07)

A Doppler system for the measurement of the velocity of missiles and ammunition is described. The basis of the design was a conventional type of Doppler radar with a CW magnetron transmitter and a receiver with IF amplifier. Due to stringent performance specifications, various improvements were introduced: (a) The magnetron was operated in a mode with low oscillator noise; (b) The magnetron was stabilized with a high-Q cavity; (c) A special antenna system with low RF leakage between the transmitting and receiving antenna was developed; and (d) Special non-tracking-filters were used in the Doppler signal path. The Doppler radar developed and produced has at present a range of approximately 1600 meters for 5" rockets, but various improvements have been contemplated and some have been tested. A range improvement by a factor of 4 seems feasible. Author

N67-13938 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

INTEGRATED TRAJECTORY SYSTEM, CHAPTER 17

Gus F. Bigelow *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 281–306 refs (See N67-13921 04-07)

A medium to high accuracy, multiple-target tracking system is being developed. Range and angle measuring equipment will employ continuous wave (CW) phase comparison measurements. Velocity measuring equipment will employ CW Doppler measurements. Author

N67-13939 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

METHODS FOR OBTAINING VELOCITY AND RANGE INFORMATION FROM CW RADARS, CHAPTER 18

Mahlon Easterling *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 307–326 refs (See N67-13921 04-07)

Continuous wave radars are particularly suited for obtaining velocity and range information on single targets at extreme ranges whether they be spacecraft in orbit about the earth or en route to the Moon or another planet, or natural celestial bodies such as the Moon or inner planets. The carrier itself provides the means for determining the velocity of the target because of the Doppler shift of the returned signal. Ways of measuring this Doppler shift for both coherent and noncoherent returned signals are discussed. The determination of range requires that the carrier be modulated. Methods of deriving modulating waveforms from pseudo-random sequences which are suitable for achieving high resolution and accuracy and resolving ambiguity are given, as well as ways of extracting the range from a returned signal. Techniques are described for both the coherent and noncoherent carriers. The several techniques described have all been embodied in actual radar systems and used to track appropriate targets. Experimental results are given to show the performance which can be attained. Author

N67-13941 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE DESIGN OF A VERY HIGH POWER, VERY LOW NOISE CASSEGRAIN FEED SYSTEM FOR A PLANETARY RADAR, CHAPTER 20

P. D. Potter *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 373–395 refs (See N67-13921 04-07)
(Contract NAS7-100)

A modified Cassegrain feed for an 85 foot diameter antenna, planetary radar system is described. The equipment and techniques involved are being developed for use in the Deep Space Instrumentation Facility. The system operates at a frequency of 2400 mc/s in a duplex mode with a transmitter power of 100 kW CW and an overall receiving system noise temperature of about 28°K. The feed system utilizes a non-optical sub-reflector and a suppressed sidelobe feedhorn to achieve an overall aperture efficiency of 0.65 and, including atmospheric effects, a zenith antenna noise temperature of 10°K. A versatile polarizing system provides for either sense of circular polarization or any orientation of linear polarization. Detailed design and performance information is presented. Author

N67-13942 Rome Air Development Center, Griffiss AFB, N. Y.
ELECTRONICALLY SCANNED ANTENNA SYSTEMS, I, CHAPTER 21
Moses A. Diab and Thomas Maggio *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 397–415 refs (See N67-13921 04-07)

During recent years much effort has been expended in the development of techniques for accomplishing electronic scanning for application to phased array radars. This has led to the development of a variety of beam scanning and beam forming techniques. The purpose of this report is to acquaint the reader with the various forms and implementation of these techniques which have been developed to date. A bibliography of those techniques which have appeared in print is included for those who wish to pursue the subject in greater detail. Author

N67-13943 Admiralty Surface Weapon Establishment, Portsmouth (England).
ELECTRONICALLY SCANNED ANTENNA SYSTEMS, II, CHAPTER 22
E. A. Killick and D. E. N. Davies (Birmingham Univ.) *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 417–431 (See N67-13921 04-07)

Basic methods are presented for electronic scanning of aerial beams. The feed complexity of a large phased array can be reduced by the grouping of elements which are fed together. Other simplifications result from space tapering and array thinning. The phase relationships in the array may be varied by the use of continuously variable or quantized phase shifters, and frequency scanning can achieve the same result. An account is given of various techniques for the formation of multiple beams. Author

N67-13944 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH POWER C.W. RADAR TRANSMITTER, CHAPTER 23
Walter S. Baumgartner *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 433–465 (See N67-13921 04-07)

The operational high-power CW radar transmitter is described. Some preliminary discussion of the space telecommunications problem, the existing Deep Space Network, and the continuing program of advanced system development is presented. The system in which the transmitter functions is described and its use as a planetary radar and as a proving ground for equipment is discussed. The design parameters for such a transmitter are delineated and the history of its development is traced. Particular attention is given to problems encountered and to their solutions. There is a detailed description of the hardware involved. Plans for increasing the radiated power still further and upgrading the transmitter system are presented. Author

N67-13945 Royal Radar Establishment, Malvern (England).
TRANSMITTER RESEARCH IN THE U.K., CHAPTER 24
N. S. Nicholls *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 467–472 (See N67-13921 04-07)

A survey is presented of the in-house and extra-mural activities of an electronics research group in the field of devices and techniques for pulsed radar transmitters. Areas covered include microwave transmitting valves, pulse modulation, hydrogen thyratrons, solid state modular switches, auxiliary devices for network type of modulators, an experimental 100 MW 400 mc/s transmitter, and an experimental 20 MW 200 kW 400 mc/s transmitter. C.T.C.

N67-13946 General Electric Co., Monmouth, N. J.
PHASE SHIFTERS FOR PHASED ARRAY ANTENNAS, CHAPTER 25
H. A. Hair *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 473–483 refs (See N67-13921 04-07)

Fast switching microwave phase shifters are discussed for use in high power array radars. Drive control techniques which minimize temperature sensitivity and which allow unique phase variation control with a minimum drive power requirement are described. Peak and average power capability of the phase-shifters are discussed. Author

N67-13947 Marconi Co., Ltd., Chelmsford (England).
DISPERSORS FOR PULSE COMPRESSION SYSTEMS, CHAPTER 26
P. S. Brandon, O. E. Keal, and W. S. Mortley *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 485–514 refs Presented at a Meeting of the Radar and Navigational Aids Group on the Inst. of Electron. and Radio Engr. Submitted for Publication (See N67-13921 04-07)

Two types of apparatus for producing the dispersion required in a pulse compression system are described. The first type is composed of lumped electric circuits and has reached an advanced stage of development, while the second makes use of ultrasonic techniques and is in the experimental stage. Consideration is given to the design of the electric circuit dispersor and the realization of a typical design, as well as to the ultrasonic dispersor. Author

N67-13948 Marconi Co., Ltd., Chelmsford (England).
RADAR DATA-HANDLING AND DISPLAY SYSTEMS FOR USE WITH PULSE RADARS, CHAPTER 27
A. P. Young *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 515–523 (See N67-13921 04-07)

A brief discussion is given of military radar data handling and display systems for pulse radars. An outline is presented of data flow in such a system, with consideration given to such components as a marked raw radar display, a synthetic plan position indicator, a cathode ray tube tabular display, a tracker ball control, and a tabular display system. General design problems are discussed, and it is shown that limitations are imposed only by the capability of the computer. C.T.C.

N67-13949 Hahn-Meitner-Institut für Kernforschung, Berlin (West Germany).
DIGITALISATION OF RADAR SIGNALS AND THEIR EVALUATION BY A COMPUTER FOR AUTOMATIC TRACKING OF TARGETS, CHAPTER 28
K. V. Schlachta, H. Sringer, W. Storz, and W. D. Wirth *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 525–539 (See N67-13921 04-07)

The real time system for evaluating surveillance radar signals for scanning the air space is described. Since the present digital radar system can only observe, the feedback on the aircraft must be accomplished by the air controller. It is planned to extend the present system to a general automatic collision warning set-up. A digital detector is described for processing the surveillance radar echoes so that they can be computerized; as are the storage, association, and identification of signals by this detector. The functional connection between the various parts of the digital radar system are discussed, including task descriptions and digital logic; and the computer program for radar data processing is described. Tactics of automatic target tracking and continuous acquisition of new targets are emphasized. M.W.R.

N67-13950 SHAPE Air Defense Technical Center, The Hague (Netherlands).
EVALUATION OF TRACK-WHILE-SCAN COMPUTER LOGICS, CHAPTER 29
L. Leth-Espensen *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 541–563 (See N67-13921 04-07)

The increasing number of vehicles which utilize the airspace demands a detailed knowledge of the positions, vectorial velocity, height and identification of all flying objects. This requirement is by no means just a military one, but pertains as well to the solution of the air traffic control problem. Automatic tracking of aircraft based on radar-derived data is a well-established method in "Airspace Management." At the SHAPE Technical Center the problem of evaluating the tracking performance of various proposed

systems for airspace management was recognized several years ago. A number of methods have been tried, and the important points which led to the method finally adopted are highlighted.
Author

N67-13951 Royal Radar Establishment, Malvern (England).
TRACKING IN AN AIR TRAFFIC CONTROL ENVIRONMENT, CHAPTER 30
B. W. Oakley *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 565–583 (See N67-13921 04-07)

Necessity for tracking and difficulties encountered are discussed in relation to an air traffic control (ATC) environment. Tracking is required to maintain the current position of aircraft in track stores containing other data on those aircraft, as well as to provide the current velocity of aircraft. Differences that may arise between a cooperative ATC environment and a purely military situation are considered, as are the cooperative methods that can be undertaken to provide the necessary information for both military and civilian needs. Improvements in conventional primary radar tracking methods, and tracking logics are reviewed.
M.W.R.

N67-13952 Federal Aviation Agency, Washington, D. C.
PROVISION AND USE OF ALPHANUMERIC DISPLAY OF PRIMARY AND SECONDARY RADAR TRACKING DATA IN EXPANDING AIR TRAFFIC CONTROL SYSTEM CAPACITY, CHAPTER 31
L. E. Shoemaker *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 585–600 (See N67-13921 04-07)

A description is given of the center-metroplex configuration for air traffic control capability improvement through automation of control functions. The terminal equipment configuration is discussed along with the operational characteristics of the computer for the center-metroplex configuration. Consideration is given to implementation of two different phases of the equipment configuration, and the various operational improvements are summarized.
C.T.C.

N67-14191 Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electric Engineering.
DETECTION OF CODED PHASE AND PHASE MODULATED SIGNALS
Lars-Henning Zetterberg Jan. 1966 34 p refs
(Rept.-66-1) CFSTI: HC $2.00/MF $0.50

A system transmits data as phase modulated signals over a noisy channel. In each of r subintervals the carrier phase has one of p possible values where p is a prime number. The first k phase coordinates are specified by the information source while the other r-k coordinates are derived through a linear coding scheme in a polynomial field of $M=p^k$ elements. The receiver contains a phase detector and a decoder that operates algebraically on quantized phase values using a polynomial representation. It explores the fact that a correctable error must contain at least one member of a small set of error polynomials. The probability of a decoding failure and the required amount of computation is studied in detail when $p=3$. The average amount of computation is small for codes of moderate length but at a certain critical length it starts to increase exponentially. Numerical results on the probability of a detection failure is available when $p=3$ and 5 for $M<1000$. They show a degradation in SNR of more than 3db compared to an ideal detector.
Author (ESRO)

N67-14192# Royal Aircraft Establishment, Farnborough (England).
THE EFFECT ON THE SPECIFICATION AND ANALYSIS OF AUTOMATIC LANDING PERFORMANCE OF IGNORING THE FEEDBACK NATURE OF I.L.S. BEAM BENDS
B. D. Armstrong Apr. 1966 25 p refs
(RAE-TR-66113) CFSTI: HC $1.00/MF $0.50

I.L.S. reflection interference should properly be considered as a feedback term in the study of control systems for automatic landing, but for convenience it has always been treated in a simpler open-loop fashion. This paper reports a qualitative study of the consequences of this simplification and finds them to be negligible both in control system analysis and in beam calibration procedures.
Author (ESRO)

N67-14211*# Ohio State Univ. Research Foundation, Columbus. Dept. of Electrical Engineering.
RECEIVER TECHNIQUES AND DETECTORS FOR USE AT MILLIMETER AND SUBMILLIMETER WAVE LENGTHS Annual Report, 1 Oct. 1965–30 Sep. 1966
30 Sep. 1966 7 p
(Grant NSG-74-60)
(NASA-CR-80831; Rept.-1093-33) CFSTI: HC $1.00/MF $0.50 CSCL 09F

A brief summary of research accomplishments during this period is presented. Discussed are an investigation of water vapor absorption in the submillimeter region, submillimeter wavelength laser studies, and theoretical studies of molecular gases.
R.N.A.

N67-14213*# California Univ., Berkeley. Space Sciences Lab.
OPTIMIZATION OF DESIGN OF SPACE EXPERIMENTS FROM THE STANDPOINT OF DATA PROCESSING Semiannual Report, May 1–Oct. 31, 1966
S. Silver, D. Sakrison, and V. R. Algazi 30 Sep. 1966 21 p refs *Its* Ser. No. 7, Issue No. 48
(Grant NGR-05-003-143)
(NASA-CR-80830) CFSTI: HC $2.00/MF $0.50 CSCL 09F

Efforts to develop an encoding algorithm suitable for implementation on a small general purpose computer are described, and several aspects of source encoding of random data processes are considered. The problems involved in determining an acceptable tolerance in reproducing the data are discussed, along with the representation of signals of finite duration by digital means. An encoding algorithm, based on certain properties of optimum codes, was designed to yield a fixed but programmable fidelity criterion so that when the properties of the source change, a corresponding change in the average bit rate occurs. It is pointed out that the code was designed on the assumption that a short amount of raw data would be transmitted unaltered over the telemetry link and that some properties of the data source could be observed and used in designing the algorithm. The different functions performed by the algorithm are discussed in relation to the filter, Fourier expansion, quantization, digital encoding, and buffer storage. Preliminary results are assessed.
M.G.J.

N67-14220*# Michigan Univ., Ann Arbor.
PASSIVE INFRARED ACQUISITION AND TRACKING SYSTEM ANALYSIS, TASK II
John G. Braithwaite Washington, NASA, Jan. 1967 33 p refs
(Contract NAS5-9585)
(NASA-CR-681) CFSTI: HC $2.00/MF $0.50 CSCL 17E

When the Apollo Command Module returning from a lunar mission enters the earth's atmosphere, considerable radiant energy is emitted from the surface of the module and from the shocked air and wake surrounding the module. Detection of this radiation by an acquisition and tracking system is complicated by background radiation, which is defined. The spectral properties of both source and background radiation are analyzed to determine the optimum wavelength region for operating an optical acquisition and tracking system. The determination of the spectral properties of the target by a parallel Task I report is cited. The target spectral intensity shows a maximum and the background spectral radiance a minimum in the 3- to 5-μ wavelength band, from which it is demonstrated that this is the optimum operational wavelength region. From an analysis of the literature on atmospheric transmission the conclusion is drawn that the upper atmosphere will be very transparent over most of this wavelength range.
Author

N67-14284# European Space Vehicle Launcher Development Organization, Paris (France). Basic Techniques Div.
ASPECTS OF A HYPERBOLIC SPACE LOCALIZATION SYSTEM
E. Cambi Aug. 1966 27 p
(ELDO-TM-F-34) CFSTI: HC $2.00/MF $0.50

A self-consistent principle of localization for a space vehicle is examined. Localization is based on the measurement aboard, of three distance-differences from four fixed, passive ground stations. Carrying out the discussion on a typical geometry, it is found that the performance is very poor at large ranges (in comparison to the basis size), but that, at close ranges, the results are encouraging enough to conclude that the principle can possibly replace (or usefully complement) the conventional range-downrange tracking system. Author (ESRO)

N67-14291# European Space Vehicle Launcher Development Organization, Paris (France). Future Program Div.
SYNTHESIS OF A CLASS OF HIGHLY ACCURATE RADIO GUIDANCE AND TRACKING STATIONS
R. Cosaert (Charleroi, ACEC) Oct. 1966 7 p refs
(ELDO-TM-F-36) CFSTI: HC $1.00/MF $0.50

The synthesis of a highly accurate multichannel transponder system is examined and a comparative analysis is made with respect to range and range rate and interferometer systems. The choice of the basic station parameters is discussed and a method for evaluating the improvement on rough measurements obtained by optimum filtering, is proposed. This method involves use of a model for noise due to tropospheric turbulence. Author (ESRO)

N67-14324# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
IMPEDANCE OF A FINITE INSULATED ANTENNA IN A COLD PLASMA WITH A PERPENDICULAR MAGNETIC FIELD Interim Scientific Report
Janis Galejs 25 Jul. 1966 36 p refs
(Contract AF 19(628)-5718)
(RR-495; S-5158-4; SR-4; AFCRL-66-553; AD-640065) CFSTI: HC $2.00/MF $0.50

A variational formulation is developed for the impedance of a finite strip antenna embedded in a planar dielectric slab which is surrounded by a magnetoionic medium (cold electron plasma) with a static magnetic field impressed in a direction perpendicular to the antenna surface. Closed form expressions are obtained in the limit of low frequencies, and for a short antenna in a uniaxial medium. The impedance becomes large at the plasma frequency, near the upper hybrid resonance frequency and further resonances are observed near the gyro-frequency if the gyro-frequency exceeds the plasma frequency. The reactance of a short antenna is inductive at low frequencies, but becomes capacitive as the thickness of the insulation around the antenna is increased. Author (TAB)

N67-14325# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
IMPEDANCE OF AN INSULATED LINEAR ANTENNA FOR LAYERS OF COMPRESSIBLE PLASMA
Janis Galejs 25 Jul. 1966 31 p refs
(Contract AF 19(628)-5718)
(RR-496; S-5158-5; SR-5; AFCRL-66-554; AD-640066) CFSTI: HC $2.00/MF $0.50

A flat strip antenna is embedded in a planar dielectric slab, which is surrounded on both sides by layers of compressible isotropic electron plasma. Several closed form expressions are obtained for the impedance with a sinusoidal current distribution along the antenna. The antenna impedance is computed numerically when considering the perturbations of the antenna current by surface waves. Except for thin plasma layers, the antenna impedance can be computed using the same current distribution as for a cold plasma. This supports the validity of earlier work which neglects the perturbation of the antenna current by plasma waves. However, it is essential to consider the finite transverse dimension of the antenna and the presence of an insulating layer or of an ion sheath.
Author (TAB)

N67-14328# Utah Univ., Salt Lake City. Upper Air Research Lab.
IMPEDANCE MEASUREMENTS OF UNBALANCED ROCKET ANTENNAS NEAR THE EARTH'S SURFACE Interim Report
Rulon K. Linford and Kay D. Baker Aug. 1966 75 p refs
(Contract AF 19(628)-5044
(UU-66-10; SR-1; AFCRL-66-658; AD-640078) CFSTI: HC $3.00/MF $0.75

An investigation was conducted to explore the possibility of accurately determinining the free space impedance of a single, unbalanced, whip antenna mounted on a rocket. A system was developed to measure the impedance without any external electrical connection to the rocket. A method of suspending the rocket model was developed so that an error of less than 2 ohms was introduced into the impedance of the electrically short antenna by surrounding objects including the earth. The effects of frequency and geometry of the rocket-antenna system on the minimum height at which the rocket can be supported above the ground for accurate measurements were investigated. It was found that for antennas between 2 and 8 meters, rocket diameters between 0.2 and 0.5 meters, and frequencies between 10 and 12 Mhz, that a support height of 2.5 meters for the rocket model was sufficient for accurate measurements. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N67-13601*# Arizona Univ., Tucson. Engineering Experiment Station.
REPORTS ON HYBRID-COMPUTER HARDWARE
[1965] 35 p refs
(Grant NsG-646)
(NASA-CR-80711; EES-11) CFSTI: HC $2.00/MF $0.50 CSCL 09B

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1. A FAST MODE-CONTROL SWITCH FOR ITERATIVE DIFFERENTIAL ANALYZERS H. R. Eckes 5 p refs (See N67-13602 04-08)
2. A FAST ANALOG COMPARISON FOR HYBRID COMPUTATION R. H. Whigham 3 p (See N67-13603 04-08)
3. REDUCTION OF DIGITAL NOISE IN HYBRID ANALOG-DIGITAL COMPUTERS G. A. Korn 2 p refs (See N67-13604 04-08)
4. A HYBRID-CODE DIFFERENTIAL ANALYSER E. P. O'Grady 9 p refs (See N67-13605 04-08)
5. THE UNIVERSITY OF ARIZONA ANALOG/HYBRID COMPUTER LABORATORY G. A. Korn 4 p (See N67-13606 04-08)
6. UNIFORM GRAPHICS FOR SIMULATION 4 p (See N67-13607 04-08)

N67-13602*# Arizona Univ., Tucson.
FAST MODE-CONTROL SWITCH FOR INTERATIVE DIFFERENTIAL ANALYZERS
H. R. Eckes *In its* Rept. on Hybrid-Computer Hardware [1965] 5 p refs (See N67-13601 04-08) CFSTI: HC $2.00/MF $0.50
(Grants NGR-03-002-024; AF-AFOSR-89-64)

The design and circuit analysis of a new switched amplifier mode control circuit designed for the ASTRAC II iterative differential

analyzer are described. The bandwidth of the circuit in track is down 3 dB at 2.5 Mc, which accounts for a phase shift of 0.005 radian (<0.3 deg) at 10 Kc. The circuits switch into compute (hold) in less than 80 ns; two or more integrators switch within 20 ns of each other. Voltage drift in the track or reset mode is within ±50 V/°C between −20° to 60°C. Author

N67-13603*# Arizona Univ., Tucson.
A FAST ANALOG COMPARISON FOR HYBRID COMPUTATION
Robert H. Whigham *In its* Rept. on Hybrid-Computer Hardware [1965] 3 p (See N67-13601 04-08) CFSTI: HC $2.00/MF $0.50
(Grants NGR-03-002-024; AF-AFOSR-89-64)

The design of a new exceptionally fast analog comparator with digital output for hybrid computation is described. A wide-band dc amplifier with regenerative feedback permits highspeed comparator operation within 100 ns of zero crossing for all input rates of change between zero and 5×10^5 volts/second. Static hysteresis between ±10 mV and ±40 mV improves noise immunity. Drift is less than 25 microvolts per degree centigrade without chopper stabilization, which is optional. A simple two-transistor circuit provides both the regeneration and the digital output. Author

N67-13604*# Arizona Univ., Tucson.
REDUCTION OF DIGITAL NOISE IN HYBRID ANALOG–DIGITAL COMPUTERS
Granino A. Korn *In its* Rept. on Hybrid-Computer Hardware [1965] 2 p refs (See N67-13601 04-08) CFSTI: HC $2.00/MF $0.50

Techniques to reduce noise with old or new digital logic are reviewed. Ways of reducing the noise at the source, by grounding and shielding, and by using decoupling filters are outlined. The special problem posed by analog switches and comparators is mentioned. N.E.N.

N67-13605*# Arizona Univ., Tucson.
A HYBRID-CODE DIFFERENTIAL ANALYZER
Emmett Pearse O'Grady *In its* Rept. on Hybrid-Computer Hardware [1965] 9 p refs (See N67-13601 04-08) CFSTI: HC $2.00/MF $0.50
(Grants NGR-03-002-024; AF-AF-89-64)

A hybrid code system employing a 5-bit-plus-sign number and an analog channel accurate to within one per cent of analog half-scale is described. Results of the sine loop test verify that the predicted theoretical performance is achieved in practice. Further experiments study the performance of the hybrid code system with a passive RC integrator replacing the active integrator in the analog channel of the hybrid code integrator. Results of the sine loop test indicate that sufficient accuracy for practical applications cannot be achieved with a realizable passive RC integrator. Author

N67-13606*# Arizona Univ., Tucson.
THE UNIVERSITY OF ARIZONA ANALOG/HYBRID COMPUTER LABORATORY
Granino A. Korn *In its* Rept. on Hybrid-Computer Hardware [1965] 4 p (See N67-13601 04-08) CFSTI: HC $2.00/MF $0.50

The laboratory facilities and instruction program for the study and development of computing devices, systems, and techniques are described briefly. The undergraduate course, required of all engineering students, and the graduate program are mentioned. N.E.N.

N67-13607*# Arizona Univ., Tucson.
UNIFORM GRAPHICS FOR SIMULATION
In its Rept. on Hybrid-Computer Hardware [1965] 4 p (See N67-13601 04-08) CFSTI: HC $2.00/MF $0.50

Symbols and methods of laying out analog and hybrid computer diagrams are presented. It is recommended that only the essential signal flow is shown, rather than patching details. The symbols are illustrated and described. N.E.N.

N67-13730# Joint Publications Research Service, Washington, D. C.
TELEGRAPH INPUT–OUTPUT DEVICES FOR DIGITAL COMPUTER SYSTEMS
17 Nov. 1966 18 p Transl. into ENGLISH from Mekhaniz. Avtomatiz. Proizv. (Moscow), no. 8, Aug. 1966
(JPRS-38691; TT-66-33115) CFSTI: $1.00

CONTENTS:

1. DIGITAL RECEIVER-PRINTER FOR TELEGRAPH LINES V. M. Kuprin and Yu. N. Lipin p 1–5 (See N67-13731 04-08)
2. LINKING OF DIGITAL COMPUTERS WITH TELEGRAPH COMMUNICATION CHANNELS AT A COMPUTATION CENTER O. I. Leonov p 8–14 (See N67-13732 04-08)

N67-13731# Joint Publications Research Service, Washington, D. C.
DIGITAL RECEIVER–PRINTER FOR TELEGRAPH LINES
V. M. Kuprin and Yu. N. Lipin *In its* Telegraph Input-Output Devices for Digital Computer Systems 17 Nov. 1966 p 1–5 (See N67-13730 04-08) CFSTI: $1.00

A system is described which was developed for monitoring the reliability of information received from telegraph communication lines. The digital information, usually statistical and bookkeeping information, is transmitted using telegraphic apparatus via a subscriber telegraph exchange to the central information collection point at the computation center where it is monitored and the output sent to the punchcarrier. A five track tape is used which has a transmission rate of 6.6 symbols/sec, and with good operation of the telegraph apparatus, there is an error rate of only one error per 9000 symbols. The system consists of a transmitting and receiving start–stop telegraph apparatus, cardpunches, control and monitoring blocks, and a subscriber telegraph station. These units are described in more detail. R.N.A.

N67-13732# Joint Publications Research Service, Washington, D. C.
LINKING OF DIGITAL COMPUTERS WITH TELEGRAPH COMMUNICATION CHANNELS AT A COMPUTATION CENTER
O. I. Leonov *In its* Telegraph Input–Output Devices for Digital Computer Systems 17 Nov. 1966 p 8–14 (See N67-13730 04-08) CFSTI: $1.00

High speed digital computer centers have been developed for the effective control and automatic accounting needed in the transportation of cargo. Telegraph channels are used to transmit cargo information to the computer center. As a result of different transmission rates along the telegraph channels and the different encoding systems used, an intermediate device is needed to match the operation of the digital computer to the information transmission along the telegraph channels. Magnetic drum and magnetic tape memories can provide this linkage and adequately handle the large volumes of input information with a very low error rate. These two memory units are discussed and compared. The magnetic drum memory is preferred because no design changes are required, it is a random access type memory, and it is more economical to operate. Some of the problems related to the operation of the magnetic drum linkage system are discussed. R.N.A.

N67-13801# RAND Corp., Santa Monica, Calif.
PROSPECTS OF A SPACE-BASED CRYOGENIC COMPUTER
Barry W. Boehm Jun. 1966 24 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5002-PR; AD-634121) Available from Calif. Univ. Press, Los Angeles: $1.00

Cryogenic computers using superconductive switching elements currently promise an attractive capability for very large, fast computer memories, and also for associative memories. Their major drawback is the operations and maintenance problem of keeping the computer at a temperature near absolute zero. This memorandum suggests basing a cryogenic computer in outer space to simplify its maintenance. It presents a rough functional design of a space-based cryogenic computer system, and points out the major design problems. Although it is too early to be certain, the possibility of achieving an economically feasible system in about 20 years is fairly strong. Furthermore, its success is critically dependent on the amount of effort devoted to realizing the potential capabilities of cryogenic computers and to solution of the indicated design problems. Author (TAB)

N67-13865# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MODIFICATIONS TO THE COMPUTER CODE EPITHET
M. J. Halsall Oct. 1966 12 p
(AECL-1996, Suppl.; CRRP-1197A) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Fission spectrum sources and inelastic scattering data may now be specified in the input, and corrections for forward scattering from light nuclei may be made automatically. Fast fission ratios, neutron age and advantage factors can now be calculated. Author

N67-14111*# National Aeronautics and Space Administration, Washington, D. C.
MATHEMATICAL COMPUTER PROGRAMS–COMPILATION
J. Arnold, J. Simpson, and T. Leth (IIT Res. Inst.) 1966 26 p
(NASA-SP-5069) CFSTI: HC $1.00/MF $0.50 CSCL 09B

Listed are digital computer programs for the computation of: (1) various functions; (2) vector operations; (3) matrix operations; (4) integrations; and (5) frequency and time response packages. For the most part these programs were run on IBM 7094 computers. Information is provided to allow a prospective user to assess the usefulness of each program. K.W.

N67-14147 Joint Publications Research Service, Washington, D. C.
COLLOQUY ON ELECTRONIC COMPUTERS
23 Nov. 1966 1 p Transl. into ENGLISH from Contemporanul (Romania), 14 Oct. 1966 p 1,8
(JPRS-38778; TT-66-35202) CFSTI: $1.00

Principal arguments presented in a colloquy on electronic computers are given, together with editorial comments. Construction, development, applications, training, and experiences with computers in various fields are discussed. Several conclusions were reached from the discussion: (1) At the basis of the man–computer dialogue is the common language, which must be worked out within the framework of cybernetic collectives. (2) The pilot computer centers will have an important role in the resolution of complex problems, training of specialists, and in scientific research. (3) Research in the field of computers is mainly directed at new uses and construction of improved types of computers. L.E.W.

N67-14150# Joint Publications Research Service, Washington, D. C.
THE BESM-6 COMPUTER
5 Dec. 1966 10 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 10, 1966 p 30–32a
(JPRS-38941; TT-66-35364) CFSTI: $1.00

Details are given on the BESM-6 computer which is based on semiconductor elements and has an average response of one million operations per second. As is typical of this class, the computer can solve several problems simultaneously. The special program dispatcher for this purpose provides an optimum distribution of information in the computer's memory in order that data from one problem cannot influence the solution of another; it also sees that the problems are solved in a specified sequence. Also discussed are the teletype units used for computer data input and readout, and the internal and external memory. M.G.J.

N67-14152# Joint Publications Research Service, Washington, D. C.
DISPLACEMENT DIGITIZERS
V. O. Filippov 5 Dec. 1966 123 p refs Transl. into ENGLISH of the book "Taifratory Peremeshcheniy" Moscow, Military Publishing House of the Ministry of Defense USSR, 1965 p 1–144
(JPRS-38957; TT-66-35380) CFSTI: $4.00

The principles of construction of various types of digitizers, the codes used in them, and the characteristic features of their operation are discussed in detail. Digitizer applications in industry are outlined, e.g., in systems for programmed control of machines, in automatic scales, and in remote control and monitoring systems. Digitizers operating on the reading principle are described, including digitizers with encoded scales, matrix encoding digitizers, and phasometric reading digitizers. Digitizers operating on the count method are also discussed, i.e., those with counting of increments of the accumulative type, those with a variable count interval, and those with a constant count interval. L.E.W.

N67-14157# Joint Publications Research Service, Washington, D. C.
COMPUTER CENTERS AND AUTOMATIC ACCOUNTING AND CONTROL SYSTEMS IN THE USSR
V. I. Loskutov 12 Dec. 1966 132 p Transl. into ENGLISH from the book "Vychislitel'nye Tsentry" Moscow, Main Computation Admin., Central Statistical Admin., 1966 p 1–118, 258–261
(JPRS-39062; TT-66-35485) CFSTI: $4.00

Domestic and foreign experience gained at computer centers and from individual information processing systems are generalized, and basic principles for organizing computer centers and centralized automated computational and controls systems are examined. Methods of using computer technology tools are discussed, and basic criteria for operating electronic computers are defined. Organizational structures are considered in relation to the work they conduct on scientific, engineering, and economic problems. Mechanization of primary registration and planning in industrial enterprises is considered particularly important, and the effectiveness of electronic computers for automating diverse processes of human mental labor is assessed. Basic criteria for selecting computer assemblies are specified, and brief descriptions are given on several computers. Prospects for developing computer technology in the U.S.S.R. are assessed. M.G.J.

N67-14160# Joint Publications Research Service, Washington, D. C.
MORE ABOUT MACHINE THINKING
V. P. Tugarinov 27 Dec. 1966 9 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), v. 21, no. 3, 1966 p 45-52
(JPRS-39264; TT-66-35686) CFSTI: $1.00

A rebuttal was made to various criticisms of the creation of thinking cybernetic devices. The concept of man as a machine and the associality of machines are considered. Finally, the prospects of development of cybernetics are briefly outlined. L.E.W.

N67-14239*# Case Inst. of Tech., Cleveland, Ohio. Digital Systems Lab.
A DIGITAL INTERFACE FOR THE COMPUTER CONTROL OF A REMOTE MANIPULATOR
R. J. Taylor 1966 135 p refs
(Grant NsG-728)
(NASA-CR-80843; Rept.-1-66-49) CFSTI: HC $4.00/MF $1.00 CSCL 09B

A general purpose interface for communication between a DDP-116 Computer and an arbitrary input/output device was designed and implemented. Its use and operation are described

from the viewpoints of a programmer and a device. An additional digital logic system was constructed to multiplex the interface input/output lines with the servo loops of a seven-axis remote manipulator. A General Mills Model 100 manipulator was modified to give it motions comparable to those of a PAR Model 3000. Author

N67-14255# Case Inst. of Tech., Cleveland, Ohio. Digital Systems Lab.
A COMPUTER AIDED OPTIMIZATION TECHNIQUE FOR DIGITAL SYSTEMS TIMING
J. E. Palmer 1966 271 p refs
(Grant NsG-36-60)
(NASA-CR-80848; Rept.-1-66-42) CFSTI: HC $6.00/MF $1.50 CSCL 09B

Worst case and statistical design techniques are summarized, and applicability of these techniques is discussed for the design of digital systems using microcircuits. A technique for statistical optimization using component sorting on the basis of propagation delays is presented, and examples of the expected improvement are shown. A discussion of the available technique for evaluation of statistical design results in the evaluation of a digital computer program for the DDP-116 computer. This computer program, using Monte Carlo techniques and a simulation of the system under test, is designed to be a useful engineering tool. It requires no specialized knowledge on the part of the designer, other than his ability to read logic diagrams and component specification sheets. Some design examples, using the statistical techniques and the computer evaluation are used to demonstrate applicability to digital system design. Author

N67-14272# Rocket Propulsion Establishment, Westcott (England).
A GENERAL LEAST SQUARES FIT COMPUTER PROGRAM
A. J. Meade London, Min. of Aviation, May 1966 33 p refs
(RPE-TR-66-7) CFSTI: HC $2.00/MF $0.50

An Algol program capable of fitting a general function of an arbitrary number of variables to any number of measurements of these variables is described. In addition it will solve n nonlinear equations in n unknowns and find the minimum of a function of several variables. Under certain conditions, the program can also be used to find the unknown constants of a differential equation. Author (ESRO)

N67-14333# Carson Lab., Inc., Bristol, Conn.
OPTICAL MATRIX MULTIPLIER Final Scientific Report, Jul. 1965–Jun. 1966
Arthur N. Carson Aug. 1966 26 p refs
(Contract AF 19(628)-4311)
(AFCRL-66-619; AD-640493) CFSTI: HC $2.00/MF $0.50

Development work has been performed on a parallel, analog, matrix multiplier for the rapid multiplication of very large capacity matrices using optical storage of matrix elements in a colored crystal memory and parallel optical multiplication. The original concept for the system, based on the use of three colored crystals (two for matrix-element storage, and one for multiplication) and three wavelengths of light for storage, readout, and multiplication, respectively, was modified and simplified. The final concept used only two crystals to perform the dual function of storage and multiplication, and two colors of light; it also incorporated the technique of continuous monitoring during storage to eliminate the requirement for linearity of color conversion during storage. The principal final difficulty at completion of the contract was the inability to demonstrate adequate color conversion rates in writing matrix elements into the colored crystal to assure an interesting practical device. Several promising avenues for removing this limitation with further development were described. A laboratory bench-model matrix multiplier was constructed and used to demonstrate matrix element monitoring and multiplication. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N67-13342*# Santa Clara Univ., Calif.
PHYSICAL MODELS OF ACTIVE DEVICES
Raymond B. Yarbrough *In its* Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 1–14 refs (See N67-13341 04-10) CFSTI: HC $5.00/MF $1.00

The uses and abilities of physical models of active devices are briefly discussed, and a description is given of the large signal model, which was the first model of the junction transistor applicable over a wide range of operating level. The development of a physical model of the junction transistor, which may be used to derive any of the equivalent circuits of two-part network theory by applying the proper examinations, is investigated. The Ebers and Moll relations are considered first, then the junction capacitance and surface leakage, and finally the active base. These were then combined in a general physical model. It was concluded that a large signal junction transistor equivalent circuit may be developed from a knowledge of the physical behavior of semiconductor materials and junctions. The value of the large signal model is that operation of the device over its entire range of operation (excluding avalanche effects which were not treated) may be predicted from a few static measurements and a few frequency determinations. L.E.W.

N67-13343*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATIONS OF MODELS TO CIRCUITS
William J. Kerwin *In* Santa Clara Univ. Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 15–25 (See N67-13341 04-10) CFSTI: HC $5.00/MF $1.00

The various active device models for linear circuit application are considered from the standpoint of simplicity of use, and examples of their application to the design of an operational amplifier, using the T model, and an emitter-peaked voltage amplifier stage, using the hybrid-π model, are given. Extensive diagrams are included to illustrate models, parameters, equivalent circuits, and flow graphs. L.E.W.

N67-13348*# Lenkurt Electric Co., Inc., San Carlos, Calif.
INDUCTORLESS FILTERS
H. J. Orchard *In* Santa Clara Univ. Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 92–95 refs Reprinted (See N67-13341 04-10) CFSTI: HC $5.00/MF $1.00

Because attempts to produce inductorless filters with RC-active networks have led to circuits that are much more sensitive to component tolerances than conventional LC filters, an alternate solution is proposed. The alternative considered consists of replacing each inductor in a conventional doubly loaded LC filter by a gyrator–capacitor combination. It is pointed out that the gyrator–capacitor network, like the LC network, is dissipationless and passive, and has the same low sensitivity; however, the production of a good enough gyrator remains a problem. Previous methods of gyrator production are considered, and preliminary experimental results on gyrator design are briefly discussed. L.E.W.

N67-13614# National Bureau of Standards, Washington, D. C.
TRANSISTORIZED BUILDING BLOCKS FOR DATA INSTRUMENTATION
Philip G. Stein 28 May 1966 115 p
(ARPA Order 183)
(NBS-TN-268) GPO: $0.60

A fourth family of etched circuit logic cards was developed. It closely parallels the design criteria and philosophy embodied in

previous work, but differs in many respects. Each circuit description is separated physically from the others to facilitate use as an application manual. Specifications, typical uses, graphic symbols, and reliability are discussed in brief. Author

N67-13668*# Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
HIGH RELIABILITY DC AMPLIFIER Final Report
W. Whitworth 30 Sep. 1966 92 p refs
(Contract NAS8-11922)
(NASA-CR-80723; ACF-3121) CFSTI: HC $3.00/MF $0.75 CSCL 09E

Development and fabrication of a circuit consisting of a fully differential dc amplifier and its regulated power supply is described. The amplifier contains three voltage amplification stages and an output driver stage. Open loop gain approximates 1.0 million (120 dB). Input and output are floating with common mode rejection of about 44 dB, and a nominal input impedance of 100 KΩ. The power supply consists of a dc to dc converter and regulator. Thin film and hybrid chip technologies were combined to assure minimum volume, weight, and power consumption. The assembly is used within the Saturn system in a computer for operation of the hydraulic engine controls and is the last link between man and machine. Extreme circuit reliability was stressed throughout the work. K.W.

N67-13677*# Philco Corp., Palo Alto, Calif. Western Development Labs.
RELIABILITY STUDY ON ZENER DIODES USED IN THE SATURN PROGRAM Quarterly Technical Status Report, 1 Aug.–1 Nov. 1966
W. D. Boltz 1 Nov. 1966 11 p
(Contract NAS8-20315)
(NASA-CR-80678; QTR-1) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Summarized results of a survey are presented concerning information on zener diode manufacturers and percentage of failures that occurred during testing. Also briefly mentioned are progress in the procurement of diodes, in step stress matrix evaluation, and in the arrangement of test methods and programs. K.W.

N67-13722 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
OSMIUM DISPENSER CATHODES
P. Zalm and A. J. A. van Stratum *In its* Philips Tech. Rev., Vol. 27, No. 3/4 1966 p 69–75 refs (See N67-13721 04-34)

To widen the useful scope of dispenser cathodes, the work function of the emissive surface should be reduced to a value even lower than that already achieved with a coating of adsorbed barium. This has been made possible by the paradoxical effect that the work function of a metal surface optimally covered with barium is lower for a *higher* work function of the *uncoated* metal. This effect is explained on the basis of a simple model. Of the metals rhenium, ruthenium, iridium and osmium, with which the effect has been verified, osmium gives the best results. When the tungsten body of an L cathode is coated with osmium the work function is reduced from 1.95 V to 1.60 V, making the emission density a factor of 10 higher at 8000°C. This improvement can be utilized either for operating the cathode at a lower temperature, making more economical designs and longer lifetimes possible (e.g., in disc-seal triodes several times 10,000 hours), or for achieving higher current densities (e.g., 25 A/cm^2 in a 1.5 mm reflex klystron). Author

N67-13738# Institute of Modern Languages, Inc., Washington, D. C.
A STATICAL FREQUENCY CHANGER FOR FEEDING AN ASYNCHRONOUS MOTOR WITH A VOLTAGE OF REDUCED AND ADJUSTABLE FREQUENCY [STATYCZNY PRZEMIENNIK]
Jerzy Zygmund Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Sep. 1966 21 p refs Transl. into ENGLISH from Przegl. Electrotech. (Warsaw), no. 8, 1965 p 315–319
(Contract DA-44-009-AMC-1563(T))
(T-1868-66; TT-66-62198; AD-638668) CFSTI: HC $1.00/MF $0.50

The operation of a direct statical frequency changer is described. The excitation system control conditions are pointed out for securing sinusoidal characteristics of output voltage: an equivalent circuit diagram of the changer is discussed, as well as the results obtained with a model design made of gas-filled thyratrons TG 3.2/1.5, and applied for driving an asynchronous motor rated at 3 kw. Author

N67-13816# Phillips Zentrallaboratorium G.m.b.H., Hamburg (West Germany).
ELECTRONICALLY ADJUSTABLE FERRITE PHASE SHIFTERS AND THEIR APPLICATION IN SCANNING LEAKY-WAVE ANTENNAS
G. Buchta [1966] 19 p refs Presented at 12th Symp. of the AGARD Avionics Panel, Duesseldorf, 7–12 Jul. 1966 Sponsored by W. Ger. Min. of Defence
CFSTI: HC $1.00/MF $0.50

Magnetically controlled ferrite phase shifters were evaluated for scanning purposes on leaky wave antennas. A non-reciprocal device, in which a ferrite slab was fixed asymmetrically to the wide face of a rectangular waveguide and magnetized parallel to the broad walls of the guide, showed an increase of insertion loss at higher magnetic fields due to the approach of ferrimagnetic resonance. The reciprocal ferrite phase shifter, in which the ferrite slab was symmetrically fixed on the narrow wall of a rectangular waveguide and magnetized by a static field parallel to the broad walls of the guide, proved irregular at higher frequencies due to higher order mode excitation within the magnetized ferrite loaded structure. G.G.

N67-13877*# Barnes Engineering Co., Stamford, Conn.
THERMOPILE IMPROVEMENT Final Report
Peter A. Walters 22 Jul. 1966 49 p ref Prepared for JPL
(Contracts NAS7-100; JPL-951325)
(NASA-CR-80768) CFSTI: HC $2.00/MF $0.50 CSCL 09A

This report describes investigations performed for the purpose of improving the performance of thin film thermoelectric infrared detection devices (i.e., thermopiles). This work has disclosed that the thermoelectric properties of vapor deposited films of antimony, bismuth, and tellurium are highly dependent on deposition rate. Significant correlations were also observed between thermoelectric properties, substrate temperature, and chamber pressure. With proper control of deposition parameters, bulk Seebeck coefficients of these elemental materials are easily reproduced, and film resistivities which are less than twice bulk values can be consistantly obtained. Fabrication of thermopiles using techniques developed during these studies has shown that elemental thermopile parameters (i.e., resistance, responsivity, and time constant) can be controlled to far closer tolerances than could be achieved with previously used deposition techniques. Author

N67-14174*# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
PHOTON-COUPLED ISOLATION SWITCH Quarterly Report, 1 Apr.–30 Jun. 1966
E. L. Bonin 30 Jun. 1966 12 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951340)
(NASA-CR-80820; TI-03-66-134; QR-2) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Optoelectronic techniques are being used in the development of a new type of photon-coupled integrated circuit. This device functions as an isolation switch by providing a transistor output electrically isolated from the driving sources and all other terminals of the switch. The isolation switch combines a monolithic silicon integrated driver circuit, a gallium arsenide photo emitting diode and

a silicon phototransistor. In operation, the driver circuit supplies bias for the GaAs diode, and the phototransistor, optically coupled to the GaAs diode, acts as the output transistor switch. Phototransistors satisfying the current gain and breakdown voltage requirements were fabricated. Gallium arsenide switches, which combined emitting diodes with the phototransistors, also satisfied the design objectives for coupling efficiency. Modification of the phototransistor is in process to eliminate inversion layer effects found in the present structure. Author

N67-14216*# Planning Research Corp., Los Angeles, Calif.
COMPONENT MODELING HANDBOOK
Kennath O. King, Kenneth Gillett, and William Libaw Jun. 1966 149 p Prepared for JPL
(Contract NAS7-100)
(NASA-CR-80827; R-843) CFSTI: HC $4.00/MF $1.00 CSCL 09A

Nonlinear mathematical models for a number of electronic components were developed for use with the TAG computer program for static and dynamic circuit analysis. Components modeled are the diode, transistor, zener diode, tunnel diode, controlled rectifier, junction field-effect-transistor, and saturating inductor. In developing each model, attention has been concentrated on describing the model and its performance, and on evaluating model parameters. Fortran programs for some of the more widely used components are provided. Author

N67-14257*# Texas Instrument, Inc., Dallas. Semiconductor-Components Div.
PHOTON-COUPLED ISOLATION SWITCH First Quarterly Report, 1 Jan.–31 Mar. 1966
E. L. Bonin 31 Mar. 1966 36 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951340)
(NASA-CR-80850; TI-03-66-87) CFSTI: HC $2.00/MF $0.50 CSCL 09A

A photon-coupled switch is described that provides a transistor output electrically isolated from the driving sources and all other terminals of the switch. The device consists of a monolithic silicon integrated driver circuit which supplies bias to a gallium arsenide photon-emitting diode. The emitting diode is optically coupled to an electrically-isolated silicon phototransistor. Design and breadboarding of the driver circuit has been completed. The circuit used two transistors and diode input gates which will allow up to 10 inputs in the integrated design with a 14-lead miniature package. The silicon phototransistor has been designed and diffusion masks are in process. Noise transmissibility of the transistor in the non-conductive state is determined by the device and circuit capacitances. Negligible changes in the important device parameters were exhibited for gallium arsenide emitting diodes, early types of emitting diode-phototransistor pair, and diode-transistor integrated circuit logic gates exposed to proton radiation. Author

N67-14301# Royal Aircraft Establishment, Farnborough (England).
THE CAPABILITIES OF UHF POWER TRANSISTORS
C. Fromberg Jun. 1966 65 p refs
(RAE-TR-66175) CFSTI: HC $3.00/MF $0.75

An assessment of the thermal and electrical behavior of UHF power transistors is made and compared with measurements on the best devices at present available. It is concluded that a transistor with a dissipation of 50 watts and a power gain of 6 db at 400 Mc/s is just about within the limits of present-day technology. Author (ESRO)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N67-13341*# Santa Clara Univ., Calif. Dept. of Electrical Engineering.
PROCEEDINGS OF THE INSTITUTE ON MODERN SOLID STATE CIRCUIT DESIGN
[1966] 165 p refs Inst. held in Santa Clara, Calif., 15–16 Sep. 1966; Sponsored by NASA
(NASA-CR-80512) CFSTI: HC $5.00/MF $1.00 CSCL 09C

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5. MATRICES AND STATE VARIABLES J. Staudhammer (Arizona State Univ.) p 62–76 refs (See N67-13346 04-10)
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9. NETWORK DESIGN VIA NONLINEAR PROGRAMMING E. A. Huber (Sylvania Electric Products, Inc.) p 115–121 refs (See N67-13350 04-10)
10. THE SENSITIVITY OF ACTIVE CIRCUITS R. C. Dorf p 122–134 refs (See N67-13351 04-10)
11. COMPUTER ASSISTANCE IN CIRCUIT ANALYSIS AND DESIGN W. W. Happ (NASA, Electronics Res. Center) p 135–145 refs (See N67-13352 04-10)

N67-13344*# Santa Clara Univ., Calif.
TOPOLOGICAL ANALYSIS OF PASSIVE NETWORKS
Shu-Park Chan *In its* Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 26–49 refs (See N67-13341 04-10)
CFSTI: HC $5.00/MF $1.00

A brief introduction is given to the application of network topology to the analysis of passive networks. First, a minimum set of definitions is presented. Some theorems in network topology are stated without proof, and topological formulas for computing various network functions are listed. Finally, a number of examples are given to illustrate the usefulness of these topological formulas in network analysis and to compare the conventional analysis methods. Author

N67-13345*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
TOPOLOGICAL ANALYSIS OF ACTIVE NETWORKS
R. M. Carpenter *In* Santa Clara Univ. Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 50–61 refs (See N67-13341 04-10) CFSTI: HC $5.00/MF $1.00

A compatible series of computer programs is developed for circuits with large numbers of components, typically 30 to 100. The programs utilize the dichotomy entailed in the flowgraph associated with any active network. Algorithms are established to dichotomize the network into voltage and current generators, to examine separately each set and the associated system of controls

interrelating both sets, and to establish a flowgraph in terms of a unique dichotomous representation for a given equivalent circuit. While the algorithms were developed for linear networks, the dichotomous procedures provide an approach which is not so restricted. Author

N67-13346*# Arizona State Univ., Tempe.
MATRICES AND STATE VARIABLES
John Staudhammer *In* Santa Clara Univ. Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 62–76 refs (See N67-13341 04-10) CFSTI: HC$5.00/MF$1.00

Basic algorithms for matrix manipulations by computer are presented. Matrix formulation and solution of the network equations for a linear lumped parameter network are given. An example for these is shown. Advantages and disadvantages of this procedure are briefly discussed. References are made to pertinent literature. Author

N67-13347*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RC ACTIVE NETWORKS
William J. Kerwin *In* Santa Clara Univ. Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 77–91 refs (See N67-13341 04-10) CFSTI: HC$5.00/MF$1.00

Consideration is given to an RC active network containing only resistors, capacitors, transistors, and diodes and not using inductors or transformers. The reasons given for omitting inductive components are to reduce the overall weight and size, eliminate all magnetic materials (as is needed in probes for deep space magnetic field measurements), and reduce costs. RC passive, RLC, and RC active networks are compared, and the use of negative impedance converters, operational amplifiers, gyrators, and controlled sources are described. Finally, a design example is given, using a controlled source. L.E.W.

N67-13349*# Ampex Corp., Redwood City, Calif.
ITERATIVE OPTIMIZATION TECHNIQUES FOR CIRCUIT DESIGN
Gabor C. Temes *In* Santa Clara Univ. Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 96–114 refs (See N67-13341 04-10) CFSTI: HC$5.00/MF$1.00

A survey is given of iterative optimization procedures used in circuit design when no classical synthesis technique is available, e.g., when the configuration and/or some of the element values are constrained or if unavoidable parasitics or prespecified active devices must be incorporated into the circuit. It is pointed out that the iterative technique typically requires about 10 times the computer time needed for direct synthesis. Three functions of the techniques are defined: direct design, approximation, and realization techniques. The following optimization techniques are discussed in detail: linear programming, linearization, steepest descent, step size determination, search techniques, least squares, hybrid method, generalized Remez method, zero-shifting, coefficient matching, nonlinear programming, incorporation of constraints in the optimization, and the Carroll–Fiacco–McCormick technique. L.E.W.

N67-13350*# Sylvania Electric Products, Inc., Mountain View, Calif.
NETWORK DESIGN VIA NONLINEAR PROGRAMMING
E. A. Huber *In* Santa Clara Univ. Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 115–121 refs (See N67-13341 04-10) CFSTI: HC$5.00/MF$1.00

The network design problem is considered a minimization problem and iterative gradient techniques are used to automatically adjust the network element values to approximate a desired network response with minimum error. Constraint equations are used to insure physical realizability. With this formulation the design problem becomes a nonlinear programming problem. The result is an automatic procedure which uses the circuit designer's experience in setting up the problem but requires no tedious labor on his part. Author

N67-13351*# Santa Clara Univ., Calif.
THE SENSITIVITY OF ACTIVE CIRCUITS
Richard C. Dorf *In its* Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 122–134 refs (See N67-13341 04-10) CFSTI: HC$5.00/MF$1.00

The sensitivity of an active circuit to parameter variations is an important consideration in the analysis and design of modern solid-state circuits. In this paper, several useful sensitivity indices will be discussed and illustrated. It will be shown that the root sensitivity which is calculated on the basis of the state vector differential equation is particularly suitable for digital computer calculations. Author

N67-13352*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
COMPUTER ASSISTANCE IN CIRCUIT ANALYSIS AND DESIGN
William W. Happ and John Staudhammer (Ariz. State Univ.) *In* Santa Clara Univ. Proc. of the Inst. on Modern Solid State Circuit Design [1966] p 135–145 refs (See N67-13341 04-10) CFSTI: HC$5.00/MF$1.00

Salient desirable features of computer programs for circuit analysis are discussed. Gross characteristics of some computer programs are given. A survey to determine the availability of computer routines for solid state circuits includes: scope of program extent of present use, range of applications, availability, interchange of programs and feedback of information. The feasibility of a pool of programs for circuit designers is examined. Author

N67-13450# Joint Publications Research Service, Washington, D. C.
METHOD OF AMPLITUDE-TIME CLASSIFICATION OF IMAGES
Yu. G. Antomonov and I. D. Ponomareva *In its* Simulation in Biol. and Med. 29 Sep. 1966 p 81–85 refs (See N67-13441 04-04) CFSTI: $5.00

A method is described which uses a three layer structure with thresholds for perception making it possible to convert an image projected on a rectangular matrix into a number sequence at the output. The differentiation of such sequences is possible by means of logic decoding networks. The method is characterized by the following features: (1) the number of sensor elements is equal to the number of rows of elements (matrix columns); (2) each threshold element is linked to all sensor elements; (3) the entire image falls onto the device in a finite number of cycles; (4) all elements have different thresholds; and (5) each image is converted into an n-discharge (1+1) digit number, where n is the number of cycles and 1 is the number of threshold elements. The application of such a structure as a perception device is promising for classes of images, the different signs of which are the cumulative amplitudes of the rows of columns. The method can also be used for the perception and classification of images possessing various defects and for constructing different learning and self-teaching devices. R.N.A.

N67-13596# Joint Publications Research Service, Washington, D. C.
TECHNICAL CYBERNETICS, PROBLEMS OF CONTROL AND INFORMATION–PROBLEMS OF SOVIET SCIENCE
V. A. Trapeznikov, ed. 13 Dec. 1966 107 p Transl. into ENGLISH of the book "Tekhnicheskaya Kibernetika. Problemy Upravleniya i Informatsii–Voprosy Sovetskoy Nauki" Moscow, "Nauka" Publishing House, 1966 104 p
(JPRS-39098; TT-66-35521) CFSTI: $4.00

Problems of Soviet technical cybernetics which affect the efficiency of operation of the national economy, the search for and utilization of existing reserves, and increases in scientific efficiency are discussed. Considered are inherent problems associated with the development of models of automatic control systems; controls in man–machine systems; control of large-scale systems; communication networks and control systems; mathematical models

of relay devices and finite automata; and computers for the synthesis and design of control devices. S.C.W.

N67-13767# Weapons Research Establishment, Salisbury (Australia).
DESIGN DATA FOR U.H.F. CIRCULATORS
K. B. Whiting Aug. 1966 39 p refs
(WPD-34) CFSTI: HC $2.00/MF $0.50

A computational technique has been utilized to solve the equations governing the circulation conditions for a ferrite-loaded stripline Y-junction. Design curves are given for various modes of circulation, for a range of stripline geometries. Experimental results for above resonance operation have shown satisfactory agreement with the calculated values, over the frequency range 700–2,500 Mc/s. Author

N67-13873*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Flight Research Dept.
OPTIMAL CONTROL OF A FLEXIBLE LAUNCH VEHICLE Final Report
Edmund G. Rynaski, Richard F. Whitbeck, and Walter W. Wierwille Jul. 1966 114 p refs
(Contract NAS8-20067)
(NASA-CR-80772; IH-2089-F-1) CFSTI: HC $4.00/MF $0.75 CSCL 09C

Linear optima. control techniques are used as a synthesis tool to conceptually design control systems for a large, highly flexible launch vehicle. Quadratic performance indices are specified, some of which include a drift minimum model, that yield a realizable optimal control law providing adequate damping of two structural modes as well as satisfactory closed-loop speed of response. These designs are shown to be relatively insensitive to bending mode shapes and slopes. A theory of optimal control is developed for systems possessing parameters whose values are known only on a sample space and an optimal compensation network is designed for a launch vehicle with an uncertain first bending mode slope. In addition, a theory is developed for a design procedure that limits the feedback gains from one or more state variables. An experiment is described that obtains optimal solutions for systems having one or more feedback gains arbitrarily set to preselected values. Author

N67-14151# Joint Publications Research Service, Washington, D. C.
BIONICS AND CONTROL SYSTEMS
V. Sokolov 5 Dec. 1966 11 p Transl. into ENGLISH from Tekhnika i Vooruzheniye (Moscow), no. 10, 1966 p 64–71
(JPRS-38960; TT-66-35383) CFSTI: $1.00

Three approaches to the science of bionics are discussed: (1) the theoretical, which attempts to create mathematical models of processes taking place in a live organism; (2) the biological, which elicits the principles constituting the basis of life activity processes; and (3) the technical, which models natural processes taking place within a living organism and, based on these models, designs technical devices and whole control systems. The development of complex automatic systems is described, with details given on self-regulating systems, the homeostat, and perceptron, and the associative neuron and its technical model. M.G.J.

N67-14208*# Villanova Univ., Pa. Research and Development Div.
COMPUTER-AIDED CIRCUIT ANALYSIS Semiannual Report, May 15–Nov. 14, 1966
Tsuto Yang and Henry T. Koohce 14 Nov. 1966 11 p refs
(Grant NGR-39-023-004)
(NASA-CR-80835) CFSTI: HC $1.00/MF $0.50 CSCL 09C

New entries to a continuing bibliography on computer aided circuit analysis and design are listed. A reliability prediction and tolerance analysis and adjustment program called STANPAK (Statistical Tolerance ANalysis PAKage) is described. An effort is being made to solve network responses in the time domain using the theory of signal flow graphs with the aid of a small digital computer. The procedure for determining a primitive signal flow graph (PSFG) is outlined. An example is given to illustrate the development of the PSFG along with some comments to indicate the algorithm used to aid in writing a digital computer program. R.N.A.

N67-14217*# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
RESEARCH ON FAILURE FREE SYSTEMS Final Report
Dec. 1966 109 p
(Contract NASw-572)
(NASA-CR-80826; WGD-38521) CFSTI: HC $4.00/MF $0.75 CSCL 09C

Details are given on the development of techniques for efficiently allocating a limited number of test points within modularly redundant digital systems, and on estimating system reliability based on the results obtained from limited testing. The block model technique, based on the concept of coherent systems, is used for the reliability analysis procedure. In the test point allocation procedure, the system model used is the block reliability model. This technique permits optimal allocation of the limited number of test points within a redundant digital system. Both procedures were programmed in Fortran IV for implementation on a general purpose digital computer. Descriptions of these two programs are given. To illustrate the applicability of the computer programs to practical systems, they were applied to the modularly redundant Mariner C spacecraft sequencer; tabulated data on the results are presented. M.G.J.

N67-14240*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
THRESHOLD STUDY OF PHASE LOCK LOOP SYSTEMS Interim Technical Report
John C. Lindenlaub and John J. Uhran Dec. 1966 165 p refs
(Grant NsG-553)
(NASA-CR-80844; TR-EE66-19) CFSTI: HC $5.00/MF $1.00 CSCL 09C

Two aspects of phase lock loop systems were investigated: the effect that the phase comparator has on overall performance and the study and defining of the threshold phenomena. Several comparators were analyzed using a Fokker–Planck model. It is shown that the additional complexity involved in using other comparators rather than the relatively simple sine comparators can be justified particularly when additional tracking range is required. For second order systems, it is shown that critical damping provides optimum performance in terms of tracking and threshold. The inclusion of a section on the limiter is given for comparison purposes. The threshold is defined in terms of the rate of cycle slipping i.e., as output spikes/sec. It is an easily measurable quantity and the acceptable level once chosen is independent of modulation, noise, and loop filter. It also provides the easiest method of comparing the thresholds of various systems since the curves are all parallel to each other. It is also shown that in many cases the output spikes follow a Poisson time distribution. Author

N67-14252*# Planning Research Corp., Los Angeles, Calif.
TAG USER'S MANUAL
Kenneth O. King, Kenneth Gillett, and William Libaw Jun. 1966 226 p Prepared for JPL
(Contract NAS7-100)
(NASA-CR-80845; R-847) CFSTI: HC $6.00/MF $1.25 CSCL 09C

A Transient Analysis Generator (TAG) program is used for automatic circuit analysis to simulate both transient and steady state behavior of a large class of electrical networks. A special analysis program is generated for each circuit described to TAG; and the language by which circuit topology, parameter values, and

type of simulation desired are detailed. The TAG program can handle a wide variety of nonlinear component models. Set up of TAG description and data decks and TAG system deck set-up are detailed following a description of the system. Limitations to TAG simulation are mentioned in this users' manual, and examples of TAG simulations are included. A listing of the users' outputs, TAG-generated solution program, and data outputs that trace a time history of the circuit are presented; and a set of curves shows several of the output variables plotted against time. M.W.R.

N67-14258*# Case Inst. of Tech., Cleveland, Ohio. Digital Systems Lab.

A HYBRID SERVO-POSITIONING SYSTEM FOR A COMPUTER CONTROLLED MANIPULATOR

Peter W. Hammond 1966 85 p refs

(Grant NsG-728)

(NASA-CR-80851; Rept.-1-66-41) CFSTI: HC $3.00/MF $0.75 CSCL 09C

An experimental facility for investigating computer control of a manipulator is described. Design features of part of the computer/machine interface presented include circuit details of a digital-to-analog convertor, an RC active filter, and a phase-switching servo-amplifier. The packaging of the various components is displayed. A basic manipulator control program illustrates the general function of the facility. Author

N67-14320# Joint Publications Research Service, Washington, D. C.

THE PRINCIPLE OF CONSTRUCTION OF A SEARCHLESS ADAPTIVE VARIABLE-STRUCTURE AUTOMATIC CONTROL SYSTEM

B. N. Petrov et al 4 Jan. 1967 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 6, Oct. 1966 p 1279–1282

(JPRS-39393; TT-67-30044)

Inherent problems associated with the construction of models of automatic control systems for evaluating the variables of an object with a velocity which is commensurable with the time of occurrence of the transient processes are discussed. Suggested is the use of the principle of adaptation in automatic control systems with variable structure as a possible approach to the solution of problems associated with the construction of high quality control systems. To demonstrate the applicability of the principle of adaptation in automatic control systems with variable structure, the problem of the automatic control of an object, the amplification coefficient of which varies within broad limits, and the rate of change of which is small as compared with the rate with which the transient process takes place; was investigated. It is shown that in an automatic control system it is possible to improve the quality of the selected criterion (the degree of stability) by the introduction of an adaptive control device which realizes the logical function:

$$c(k_j)\text{-}x \text{ for } \Delta t_{j+1} < \Delta t \leq \Delta t_j,\ j = 0,1,\ldots,1\text{-}2,$$

$$c(k_{l-1})\text{-}x \text{ for } \Delta t_l < \Delta t \leq \Delta t_{l-1},$$

where $t_j = t(b_j)$.

The constructed control system belongs to the class of searchless adaptive systems. S.C.W.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N67-13354# National Inst. for Research in Nuclear Science, Harwell (England). Central Engineering Group.

THE PLUNGING MAGNET SYSTEM FOR THE NIMROD EXTRACTED PROTON BEAM

J. H. Major and J. H. Swain Mar. 1966 87 p refs

(RHEL/R-117) HMSO: 13s

A servo-controlled hydraulic mechanism for repetitively plunging the one-ton extraction magnet for the Nimrod extracted proton beam is described. Author (NSA)

N67-13581 Dayton Univ., Ohio. Fluid Dynamics Facilities Lab.

SUMMARY OF ARL SYMPOSIUM ON MAGNETIC WIND TUNNEL MODEL SUSPENSION AND BALANCE SYSTEMS

Fred L. Daum Wright-Patterson AFB, Ohio. ARL, Jul. 1966 461 p refs Symp. held at Wright-Patterson AFB, Ohio, 13–14 Apr. 1966

(Contract AF 33(615)-3626)

(ARL-66-0135; AD-637208) CFSTI: HC $7.50/MF $2.00

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N67-13582 Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.

THE PRINCETON UNIVERSITY ELECTROMAGNETIC SUSPENSION SYSTEM AND ITS USE AS A FORCE BALANCE

R. N. Zapata and T. A. Dukes *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 1–26 refs (See N67-13581 04-11) CFSTI: HC $7.50/ MF $2.00

A three-degree-of-freedom electromagnetic suspension system which is being used to support models in a hypersonic wind tunnel for the primary purpose of studying wake characteristics is described. A high degree of decoupling between the three force axes has been achieved by making appropriate use of the symmetry of the problem. Although the system was originally designed for spherical models, it can be used to support aerodynamically stable axisymmetric bodies under certain conditions. Examples of suspension of spheres and cones in a Mach number 16 helium stream are shown. Also force calibration procedure and results are presented and discussed. Author

N67-13583 Royal Aircraft Establishment, Farnborough (England). Ministry of Aviation.

THE DEVELOPMENT, DESIGN AND CONSTRUCTION OF A MAGNETIC SUSPENSION SYSTEM FOR THE R.A.E. 7" × 7" (18 × 18 CM) HYPERSONIC WIND TUNNEL

A. Wilson and B. Luff *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 27–79 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

A magnetic suspension system for aerodynamic wind tunnel models is described. The system is designed to hold axisymmetrical models in a Mach 8 airstream. The models, which may be flown at small degrees of incidence, are controlled in five degrees of freedom. Aerodynamic forces on a model may be measured under conditions more nearly approaching those of free flight. The system is being engineered into the Royal Aircraft Establishment 18 cm hypersonic wind tunnel. Author

N67-13584 Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.

THE GENERAL FEATURES OF A SIX-COMPONENT MAGNETIC SUSPENSION AND BALANCE SYSTEM

T. Stephens *In* Dayton Univ. Sum of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 81–108 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

The general arrangement of a six-component magnetic suspension and balance system has been defined. The design of the model-position-measuring system, the suspension feedback control system, and the force and moment readout system are in the process of development and refinement. Efforts have also been directed toward the design of the magnet system and the requirements of a completely integrated six-component suspension. The design of a relatively interaction-free six-component suspension depends to a large degree upon the magnet system arrangement. Symmetrical magnet systems have been devised which allow relatively independent control of the force and moment components. Such arrangements generally provide uniform and independent magnetization fields and field gradients at the center of the test section. Symmetrical arrangements provide the additional advantages of linear current-force relations and relatively efficient use of controlled power. Two stages in the evolution of the design of a six-component magnetic suspension employing a symmetrical magnet array have been accomplished, and the design of a compact and flexible magnet system, compatible with the operations of a wind tunnel, appears to be feasible. Author

N67-13585 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SOME ASPECTS OF AN AIR-CORE SINGLE-COIL MAGNETIC SUSPENSION SYSTEM

I. L. Hamlet and R. A. Kilgore *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 109–135 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

Technical aspects in the development of an air-core, dual-wound single-coil, magnetic-suspension system with one-dimensional control are reviewed. Overall electrical system design features and techniques are discussed in addition to the problems of control and stability. Special treatment is given to the operation of a dual-wound, high-current support coil which provides the bias field and a superimposed modulated field. Other design features include a six-phase, solid-state power stage for modulation of the relatively large magnitude control current, and an associated six-phase trigger circuit. Author

N67-13586 Virginia Univ., Charlottesville. Dept. of Aerospace Engineering and Engineering Physics.

PRINCIPLES, TYPICAL CONFIGURATIONS AND CHARACTERISTICS OF THE UNIVERSITY OF VIRGINIA MAGNETIC BALANCE

H. M. Parker *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 137–157 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

The theory of the magnetic balance is developed from first principles through design charts for particular configurations. The general areas of types of application and problems encountered are discussed and the manner in which balance weight, power required, and force capacity scales with size is summarized. Current prospects for the practical application of the balance to the study of the dynamic stability of aerodynamic configurations are emphasized. Author

N67-13587 Southampton Univ. (England).

SOME FORCE AND MOMENT MEASUREMENTS USING MAGNETICALLY SUSPENDED MODELS IN A LOW SPEED WIND TUNNEL

M. J. Goodyer *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 159–197 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

The utilization of a four-component magnetic suspension system as a drag balance or models at zero incidence is discussed. The balance utilizes the lift and lateral electro-magnets only of an L type suspension system, with a wind tunnel having a horizontal working section. Two possible drag measuring techniques are proposed, and one of these has been chosen for experimental investigation. This technique is suitable for use in circumstances where the drag of the model is less than about 10% of its weight. The drag force calibration is given and factors affecting its repeatability are discussed. Some drag measurements on a blunt-based body of revolution illustrate the quality of results obtainable. At a drag force level of 0.012 lb., it is claimed that the force can be measured to an accuracy of ±2%. The same four-component balance has been used for the measurement of a roll derivative for a model fitted with thin cropped delta wings. The technique adopted was to spin the model about the roll axis and to monitor the free-body rate of decay of the rolling motion. The roll angular velocity measuring equipment is described, the accuracy assessed, and the suitability of the technique for measurements at high tunnel air speeds discussed. Author

N67-13588 Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
USE OF MAGNETIC SUSPENSION SYSTEM IN O.N.E.R.A. WIND-TUNNEL
R. Moreau *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 199-245 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

Initial research on magnetic suspension systems is reviewed. The present state of these systems is described and some of the difficulties found in the course of their development and adaptation of hypersonic wind tunnels are revealed as well as their solutions. Some results are presented and the future of such systems is discussed. Author

N67-13590 Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
SOME LIMITATIONS OF THE MAGNETIC SUSPENSION SYSTEM WHEN USED FOR DYNAMIC STABILITY TESTING
A. Copeland *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 261-281 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00
(Contract AF 33(615)-1470)

The reduced frequency and amplitude of motions obtainable in a magnetic suspension system are functions of the mass and moments of inertia of the test model, the demagnetizing factors of the test model, the field and field gradient obtainable, the dynamics of the field producing system (magnets and power supplies), and the aerodynamics of the test model. The limitations on both reduced frequency and amplitude for several typical test models as functions of the above parameters are presented and discussed with regard to the testing methods which might be employed. The expected accuracy of measurements of dynamic stability characteristics for several typical cases is discussed. Author

N67-13592 Southampton Univ. (England).
THE THEORETICAL AND EXPERIMENTAL PERFORMANCE OF ROLL CONTROL ELEMENTS IN THE SIX COMPONENT MAGNETIC WIND TUNNEL BALANCE
M. J. Goodyer *In* Dayton Univ. Sum of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 313-347 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

Two fundamentally different roll control systems have been developed for the magnetic wind tunnel balance at Southampton University. Each provides positive stiffness and near critical damping, and, within a roll angle range of $\pm 10^{\circ}$ about the mean, allows the selection of the roll attitude of the model. The first roll control system, making use of a magnetic "shaped core" within the model, was demonstrated and installed in a low speed wind tunnel, controlling the roll attitude of a winged model. The theoretical moment and force producing capability of such shaped cores is discussed, and the experimental performance presented. The second roll control system consists of battery energized coils mounted in suitable locations on the model, which are acted upon by magnetic fields generated by electromagnets around the wind tunnel. Two modes of operation are proposed, and experimental data are presented. The more promising mode is further developed and its roll oscillation damping performance is demonstrated. Details of the rolling motion optical and stabilization systems are given and possible lines of further development are discussed. Author

N67-13593 Southampton Univ. (England).
SOME FACTORS IN THE DESIGN OF MAGNETIC SUSPENSION SYSTEMS FOR DYNAMIC TESTING
M. Judd and M. J. Goodyer *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 349-385 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

Some general characteristics, difficulties and limitations of dynamic testing with magnetically suspended models are discussed together with possible improvements. Parallels are drawn between mechanical and magnetic support test techniques and the problem of large acceleration loads emphasised. It is suggested that great reductions of power requirements are possible if the model is constructed so that its outside inflexible shape is spring connected with an inner magnetic mass. The mass-spring-mass system can be tuned for a desired natural frequency. The effect on the overall feedback characteristics and some practical considerations are discussed. Author

N67-13594 Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
PRELIMINARY WIND TUNNEL TESTS OF THE R.A.E. MAGNETIC SUSPENSION SYSTEM AND A DISCUSSION OF SOME DRAG MEASUREMENTS OBTAINED FOR A 20° CONE
J. F. W. Crane *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 433-461 (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

This paper briefly describes the initial tests made in the 7" × 7" hypersonic wind tunnel using the newly installed magnetic model suspension and balance system. Drag measurements were made at zero degrees incidence on a 20° cone model at a Mach number of 8.57. A mechanical method of launching the model at the start of the test and recapturing it at the end proved satisfactory. Author

N67-13621# Stanford Univ., Calif. Linear Accelerator Center.
DESIGN OF BEAM POSITION AND CHARGE MONITORING CIRCUITS FOR THE STANFORD TWO-MILE ACCELERATOR
R. S. Larsen May 1966 93 p refs
(Contract AT(04-3)-400)
(SLAC-63) CFSTI: $3.00

The beam position and charge monitoring circuits for the Stanford two-mile accelerator are described. Circuit design and performance are outlined. NSA

N67-13640# Los Alamos Scientific Lab., N. Mex.
MEDIUM-ENERGY PHYSICS PROGRAM Quarterly Status Report, Period Ending Jul. 30, 1966
6 Sep. 1966 94 p refs
(Contract W-7405-ENG-36)
(LA-3587-MS) CFSTI: $3.00

A progress report is presented on the medium energy physics program at Los Alamos Scientific Laboratory. Topics discussed are: accelerator structures such as waveguides, Alverez drift tubes, and injectors; R-F power sources such as an 805-MHz power amplifier and control systems, a 201.25 MHz amplifier, power supply studies; accelerator control and instrumentation, accelerator physics, and building and site planning. NSA

N67-13667*# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
MULTI-COMPONENT FORCE BALANCE CONTROL SYSTEMS Final Report
James W. Moore, Eugene S. Mc Vey, and Karl C. Henderson Aug. 1966 97 p refs
(Grant NGR-47-005-026)
(NASA-CR-80725; EME-4029-103C-660) CFSTI: HC $3.00/MF $0.75 CSCL 14B

A new wind tunnel force measurement technique was necessitated by the introduction of hypersonic wind tunnels and

small, heavy test models. A new technique is presented which uses a gas bearing to support the model and a control system comprised of three separate control loops to position the model. The three forces of interest—drag, lift, and pitch—are determined by sensing and combining the servo motor currents to give the desired reading. The servo loops are composed fo sensors, amplifiers, and motors, each of which is described in detail. The theory for the design of the motors is presented. The compensation of the servo loops is described wherein the open-loop data are obtained with the system running closed-loop. A readout preparation unit is described which senses the currents and performs the appropriate addition and subtraction. Author

N67-13759# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

APPLICATION AND PERFORMANCE OF A SPINNING DISC AEROSOL GENERATOR

G. A. Sehmel *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 51–53 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

A spinning disc aerosol generator was applied in studies of the turbulent deposition of monodisperse particles. Uranine and methylene blue solutions were used as the material to generate particles from 1 to 10 μ. Observations regarding the calibration and use of this instrument are reported. The relative humidity of the sweep air is an important factor in determining the final moisture content of the particles generated and it materially influences the physical quality of the particles. The spinning disc generator continued to prove its worth as a valuable tool in the study of behavior of particles in the 1 to 10 μ size range. Author

N67-13763# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

AN ^{131}I GENERATOR FOR FIELD RELEASE STUDIES

L. C. Schwendiman *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 64–67 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Studies of atmospheric dispersion and deposition of ^{131}I require a source which gives a steady evolution of the vapor form of the isotope over a selected period of time. The oxidation of I^- in acidified $NaNO_2$ was chosen as a suitable reaction to liberate iodine in the desired form. Steady evolution was obtained by metering the iodide carrier and the tracer ^{131}I at a fixed known rate into an excess of the oxidizing agent which was continuously sparged with N_2 or air. The sparging gas flow rate was selected so that the ^{131}I was released at a rate determined effectively by the transfer of the carrier and tracer to the reaction vessel. Although tracer level runs were successfully completed on a laboratory scale, a first attempt in a field dispersion study resulted in a partial release, which was traced primarily to plating of the high level spike during the waiting period onto the stainless steel walls of the reservoir. A second run with an all glass reservoir was successful. Author

N67-13805# Joint Publications Research Service, Washington, D. C.

SOVIET PLANS FOR ACCELERATORS

A. Mints 13 Dec. 1966 6 p Transl. into ENGLISH from Nedelya (Moscow), no. 48, 20–26 Nov. 1966 p 4–5 (JPRS-39073; TT-66-35496) CFSTI: $1.00

Proposed is a new cybernetic principle for the operation of proton accelerator that automatically controls all parameters determining the beam intensity. In this system, protons with energy of about 18 Gev will be directed into a strong magnetic field ring accelerator of about 20 kilometer length. Automatic systems will modify the magnetic fields beforehand so that the projected protons cover the entire vacuum chamber and begin to circulate within it. The magnetic fields will be intensified and the particles will pick up energy from radio-frequency acceleration stations placed at intervals all around the ring chamber. In addition, automatic control systems will also maintain the resonance between the accelerating high voltage field and the rotation frequency of the particles and thus assure the formation of the necessary number of secondary particle beams. A model cybernetic proton accelerator with beam intensity of 10^{10} protons per pulse is being constructed. G.G.

N67-13846 Royal Armament Research and Development Establishment, Fort Halstead (England).

FACILITIES TO SIMULATE THE AERODYNAMICS OF CHARGED PARTICLES IN THE IONOSPHERE

W. A. Clayden *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 75–93 refs (See N67-13842 04-12)

There are a number of problems concerned with the aerodynamics of charged particles in the ionosphere which need to be resolved by laboratory experiments. The magnitude of the various parameters required in the laboratory to simulate the various regions of ionospheric flight is discussed. The range of parameters which may be obtained with various types of facility is then investigated. Facilities considered include moving fluid types such arc-heated low-density wind tunnels and ion beams and stationary fluid types in which the required ambient ionization is produced thermally or by a discharge and a disturbance is propagated by firing a model from a light gas gun, use of a rotating arm or releasing a pulse of neutral gas. Author

N67-13848 Centre National de la Recherche Scientifique, Bellevue (France). Laboratoire d'Aerothermique.

ON SOME NEW LOW DENSITY INSTALLATIONS AND THEIR ACTIVITY [SUR QUELQUES NOUVELLES INSTALLATIONS A BASSE DENSITE ET LEUR ACTIVITE]

Edmond A. Brun *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 117–125 In FRENCH (See N67-13842 04-12)

Laboratory apparatus using rarefied gas, and a 40 m^3/s low pressure wind tunnel are described. The pressure domain explored by the two wind tunnels varied from 3 to 100 microns of mercury, while the Knudson numbers ranged from 1.01 to 10. Photographs show the pumping arrangement and the experimental chamber of the wind tunnel. Graphs indicate the torsion balance, Mach number and constant speed as a function of pressure, as well as the radial variation of the Mach number as a function of static pressure. A block diagram depicts the principle of measuring the torsion angle. Technical details are also given on the magnetic suspension torsion balance, and the classic torsion balance of the wind tunnel. Transl. by R.U.

N67-13849 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

THE VKIFD LOW DENSITY WIND TUNNEL

J. J. Smolderen and J. Naveau *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 127–137 refs (See N67-13842 04-12)

The new low density wind tunnel is described and some results of initial tests with free expanding cold jets are presented. The future plans for research in the near free molecule flow regime are indicated. The wind tunnel, is driven by two large oil booster pumps with a total maximum pumping speed of about 20,000 l/s. This pumping speed is obtained in the pressure range of 1 to 5 microns of mercury. The actual flow is obtained by free expansion of a jet, the stagnation pressure to chamber pressure ratio being in the range of 30 to 100. Pressure surveys have been carried out in various jets and a free molecule probe has been used. Results are in good agreement with previous tests and with the assumption of near isentropic expansion, except at the very lowest chamber pressures. Heater developments are nearly completed and a plasma jet is going to be installed very soon. It is planned to carry out force measurements in the near free molecule regime in the hope of obtaining data on first collision corrections. Instrumentation is being developed to carry out this program and it is hoped that the first tests will take place before the coming summer. Author

N67-13940*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A DESCRIPTION OF A HIGH-PERFORMANCE MICROWAVE EXPERIMENTAL FACILITY, CHAPTER 19
H. G. Weiss *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 327–371 (See N67-13921 04-07)

A versatile new ground station has been developed for experimental space communications, radar and radio physics investigations. This installation, which has been named Haystack, employs a precise 120-foot-diameter Cassegrain antenna with a surface tolerance which should permit very efficient operation at wavelengths of 3 centimeters and a useful capability a wavelengths as short as 8 millimeters. The antenna is protected from the environment by a metal spaceframe randome and employs a digital computer in its pointing control system. Through the use of a plug-in equipment box, which can be mounted behind the moving reflector, it will be possible to conveniently carry out a variety of experiments. A versatile transmitter power supply and a high-power microwave transmitter and a low-noise receiver are incorporated in the system. Author

N67-13994# Daresbury Nuclear Physics Lab. (England).
4 GeV ELECTRON SYNCHRONTRON Progress Report, Period Ending 31 Oct. 1966
31 Oct. 1965 31 p
(DNPL-2)

A progress report is presented on the 4 BeV electron synchrotron, NINA. Topics discussed are magnets, magnet power supplies, vacuum system, r-f accelerating system, injection equipment, control and instrumentation, acceleration development, physics apparatus, and services group. NSA

N67-14000# California Univ., Livermore. Lawrence Radiation Lab.
THE "LONG JOHN" THERMO-GASDYNAMIC RESEARCH FACILITY
J. H. Pitts, J. H. Van Sant, and R. A. Corallo 20 Apr. 1966 31 p refs
(Contract W-7405-ENG-48)
(UCRL-14841) CFSTI: HC $2.00/MF $0.50

A research facility has been developed for experimental studies of heat and momentum transfer to gases flowing inside long channels. Design specifications and operating capacities and capabilities are described for the major components of the flow system and the instrumentation equipment. The facility has been designed so that investigations with flow channels of various lengths and shapes can be conducted over a large range of pressures, temperatures, and flow rates. Acquisition of final results is expedited by automatic recording of test data and by using digital computers for calculating the plotting the required data. Author (NSA)

N67-14028# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
800 MHz RF SYSTEM FOR 200 BeV ACCELERATOR
H. J. Halama 5 Aug. 1966 18 p refs
(Contract AT(30-2)-GEN-16)
(BNL-10559; AADD-116) CFSTI: HC $1.00/MF $0.50

A discussion is presented on an rf system which combines the advantages of both linear and circular accelerators. This is achieved by employing five iris-loaded structures which are grouped together in one long straight section (34m) forming a traveling wave linac. The whole accelerating system is confined to one location only, thus eliminating long cable runs, and the rf control station is located directly above the iris-loaded structures. NSA

N67-14195# Royal Aircraft Establishment, Farnborough (England).
THE DEVELOPMENT, DESIGN AND CONSTRUCTION OF A MAGNETIC SUSPENSION SYSTEM FOR THE R.A.E. 7 in. × 7 in. (18 × 18 cm) HYPERSONIC WIND TUNNEL
A. Wilson and B. Luff Aug. 1966 47 p refs
(RAE-TR-66248) CFSTI: HC $2.00/MF $0.50

A magnetic suspension system for aerodynamic wind tunnel models is described. The system is designed to hold axisymmetrical models in a Mach 8 airstream. The models, which may be flown at small degrees of incidence, are controlled in five degrees of freedom. Aerodynamic forces on a model may be measured under conditions more nearly approaching those of free flight. The system has been used to measure drag forces on a conical model. No great difficulties have been encountered in launching or recovering the model. Author (ESRO)

N67-14234*# Israel Program for Scientific Translations, Ltd., Jerusalem.
WITH SWEDISH GEOPHYSICISTS
S. L. Solovev *In its* Geophys. Bull., No. 13 1966 p 81–85 refs (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Research projects, instrumentation, and organization of the Seismological Institute of the University of Uppsala are briefly described. An outline is given of the research being conducted at the geophysical observatory at Kirun, which is located above the northern Polar Circle, including geomagnetic observations, observations of the polar aurorae, radio observations of the polar aurorae, ionospheric observations, radio wave propagation, cosmic rays, and other seismic and meteorological observations. The manufacturing of seismic and gravimetric instruments is also mentioned. L.E.W.

N67-14288# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE O.N.E.R.A. TESTING METHODS AND THEIR RECENT PROGRESS [LES METHODES D'ESSAIS HYPERSONIQUES DE L' O.N.E.R.A. ET LEURS PROGRES RECENTS]
Pierre Carriere [1966] 29 p refs In FRENCH Presented at the Collor. on Hypersonic Aerodyn. and Study of High Speed Phanomena Tech., St. Louis, France, 14–15 Jun. 1966 Submitted for Publication
(TP-371) CFSTI: HC $2.00/MF $0.50

Some O.N.E.R.A. hypersonic testing facilities, and conventional long run duration facilities for $2<M<10$ with emphasis on the R3 wind tunnel ($8<M<10$) useful for heating research (i.e. rocket stage separation, hypersonic air intakes, etc.) are described. The slow compression R4 wind tunnel for $M=14$ and the hot shot wind tunnel for ($15<M<20$) are also described. Frozen flow phenomena at the nozzle throat and their effects are also given. Author (ESRO)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N67-13397# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUMERICAL SOLUTION OF CERTAIN PROBLEMS IN THE FLOW OF VISCOUS FLUIDS
L. M. Simuni *In its* J. of Eng. 21 Jun. 1966 p 1–7 refs (See N67-13396 04-34) CFSTI: HC $1.00/MF $0.50

Navier–Stokes equations are solved numerically for different problems in the flow of a viscous fluid. R.N.A.

N67-13407*# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
MOLECULAR BEAMS FOR RAREFIED GASDYNAMIC RESEARCH
J. B. French Paris, AGARD, Apr. 1966 104 p refs Sponsored by NASA
(AGARDograph-112) CSCL 20D

Presented is the present state-of-the-art of molecular beam technology as it applies to rarefied gasdynamics, together with enough background material to illustrate the main requirements imposed on molecular beam systems in this application. A review of the reasons, methods and directions of this developing technology is given. Author

N67-13540# Lockheed Missiles and Space Co., Palo Alto, Calif.
TURBULENT BOUNDARY LAYER ON A PERMEABLE SURFACE
V. D. Sovershennyi [1966] 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhiok. i Gaza (Moscow), no. 3, 1966 p 42–51

A power law for the mixing-path length is proposed; this would permit obtaining velocity profiles which degenerate in the case of a flow without blowing and heat exchange into known power profiles. Such an approach permits obtaining analytical results for flows with a moderate pressure gradient. Author

N67-13589# Virginia Univ., Charlottesville. Dept. of Aerospace Engineering and Engineering Physics.
THE MEASUREMENT OF LOW DENSITY SPHERE DRAG WITH A UNIVERSITY OF VIRGINIA MAGNETIC BALANCE
W. M. Phillips *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 247-260 refs (See N67-13581 04-11) CFSTI: HC $7.50/MF $2.00

Measurements of sphere drag at high Mach number and in the range of about 0.4 to 5.0 for Knudsen number have been made with a magnetic balance of a special design which is described. Drag results are presented and compared with other available data. At low Knudsen numbers, the drag coefficient agrees with existing data. An apparent lack of agreement with free molecule calculations is discussed and an outline of future work is presented. Author

N67-13619# Royal Aircraft Establishment, Farnborough (England).
TWO-DIMENSIONAL TURBULENT REATTACHMENT AS A BOUNDARY-LAYER PROBLEM
J. E. Green Feb. 1966 39 p refs Presented at the AGARD Specialists Meeting on Separated Flows, Sponsored by AGARD Fluid Dyn. Panel, Rhode-Saint-Genese, Belgium, 10–13 May 1966 (RAE-TR-66059; AD-486110)

A conventional boundary layer analysis is extended to treat the development of a steady turbulent wake downstream of a base. By a process of iterative calculation, a solution is obtained in which the outer potential flow and the wake flow are compatible and mutually dependent. The wake calculation takes into account the reversed flow in the dead-air region, and the solution includes a description of the reattachment process. Attention is confined to steady, two-dimensional, incompressible base-flows. A typical solution for this type of flow is described in detail, and is shown to be in good qualitative agreement with measurements of reattachment behind rearward-facing steps. Extension of the treatment to other types of steady separated flow is thought possible. As a result of the analysis, a way of qualitatively discussing reattachment is suggested and a recent correlation of experimental data is supported. Author (TAB)

N67-13680*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF LIQUID-PROPELLANT REORIENTATION
Jack A. Salzman and William J. Masica Washington, NASA, Jan. 1967 22 p refs
(NASA-TN-D-3789) CFSTI: HC $1.00/MF $0.50 CSCL 20D

As a part of study of liquid propellants stored in space-vehicle tanks while exposed to weightlessness, the mechanism of liquid reorientation from an initially highly curved interface by low-level accelerations was examined. Used were several propellant tank models with radii ranging from 1.27 to 5.16 centimeters and liquids possessing near 0° contact angles on the tank materials and having viscosities of the order of unity. The results indicate that, while liquid rebounding or geysering will occur in most practical reorientation maneuvers, there exists a distinct region in which geysering will not occur. A criterion consisting essentially of a dimensionless Weber number grouping successfully delineated the regions of geysering and no geysering within experimental limitations. Quantitative results of liquid accumulation rates that would allow time estimates for complete liquid reorientation are heavily dependent on overall geyser dynamics. Author

N67-13706# Lockheed Missiles and Space Co., Palo Alto, Calif.
EXCHANGE OF VIBRATIONAL ENERGY BETWEEN COMPONENTS OF AIR BEHIND A NORMAL SHOCKWAVE FRONT
L. I. Turchak [1966] 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. i Gaza (USSR), no. 4, 1966 p 171–174

Two mechanisms that actively participate in the relaxation of the vibrational energy of particles of a multicomponent gas mixture behind a shock wave are: (1) transition of the progressive energy of the colliding molecules into vibrational energy and (2) exchange of vibrational energy between molecules of different components during the collisions. The exchange process is studied as a function of shock velocity, and the critical domain when the second mechanism becomes less than the first is investigated. Computations were made at Mach numbers between 3 and 20, and the exchange process becomes insignificant for oxygen at lower Mach numbers ($M \approx 10$) than for nitrogen ($M \approx 12$). It is found necessary to account for the different mechanisms in analyzing the vibrational relaxation in air behind a shock wave depending on the free stream. For $M \leq 10$, the relaxation of the vibrational energy of oxygen is determined by both mechanisms, while the vibrations of nitrogen are excited only by the transfer of energy. For $M \geq 12$, the exchange mechanism has practically no effect on the vibrational relaxational process of the components and the size of the nonequilibrium zone. M.W.R.

N67-13711# Library of Congress, Washington, D. C. Aerospace Technology Div.
EXPERIMENTAL INVESTIGATION OF JET FORMATION BEHIND A SHOCK FRONT DURING DISCHARGE FROM DIVERGENT AND SUPERSONIC NOZZLES [IKSPERIMENTAL'NOYE ISSLEDOVANIYE FORMIROVANIYA STRUI ZA FRONTOM UDARNOY VOLNY PRI ISTECHENII IZ PASKHODYASHCHIKHSYA I SVERKHZVUKOVYKH SOPEL]
A. I. Starshinov 30 Aug. 1966 7 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh., i Astron. (Leningrad), v. 4, no. 19, 1965 p 166–168
(ATD-66-77)

A shock tube with a nozzle attached to its open end was used as the experimental apparatus. The dimensions of the nozzles are shown in a table. Results established that the character of the flow formation in the discharge from nozzles is exactly the same as in the discharge from cylindrical ducts. The flow parameters behind the shock front during discharge from nozzles depend only on the value of the gas dynamic parameters at the nozzle edge behind the shock wave. The relationships determining the flow parameters for cylindrical ducts and nozzles are the same. Author

N67-13733# Drexel Inst. of Tech., Philadelphia, Pa.
SOLUTION OF BLAST WAVES BY A CONSTANT TIME SCHEME IN THE METHOD OF CHARACTERISTICS
Shih Lien Huang and Pei Chi Chou Aug. 1966 39 p refs
(Contract DA-18-001-AMC-878(X))
(Rept.-125-9; AD-638859)

The numerical method of characteristics with constant time grids is applied to the plane blast wave problem. The calculation

begins at a constant time line bounded by the shock front and a fixed back boundary which lies halfway between the shock front and the time axis. Along the initial time line, all three flow variables are prescribed and on the back boundary, the local flow velocity is prescribed. The prescribed values are calculated from the similarity solution. For the shock front, the strong shock equations are applied. When compared to the exact similarity solution, the results of this method are found to be accurate to within .5% for all variables throughout the region of calculation, after a pressure drop of 98%. Both h^2-type and h-type extrapolations of calculated results improve the accuracy; however, h-type extrapolation is more favorable. The effects on the domain of dependence and range of influence are studied briefly. Author (TAB)

N67-13749# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

EQUATIONS DESCRIBING THE SIMULTANEOUS FLOW OF TWO IMMISCIBLE FLUID PHASES IN HETEROGENEOUS POROUS MEDIA

R. W. Nelson *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 19–22 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Theoretical work leading to the description of fluid flow in a heterogenous porous medium has developed slowly and somewhat sporadically even though the areas of engineering applications predominantly involve flow in nonhomogeneous media. In providing a theoretically consistent basis for analysis, the special characteristics of macroscopically heterogeneous materials are discussed to provide accurate definitions. The definitions establish the functional dependence and make mathematical representation possible. The special implications of heterogeneity on Darcian-type dynamic relationships for each of the fluid phases are considered. The end result is a set of rather general Eulerian equations describing two-phase flow in a macroscopically heterogeneous medium. These equations and their reduced forms include description of some 40 different flow systems. Such a variety of flow conditions is categorized through the use of a special tabular scheme which makes it possible to write the appropriate equations very efficiently. Author

N67-13760# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

SUBISOKINETIC SAMPLING OF PARTICLES IN AN AIR STREAM

G. A. Sehmel *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 53–58 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

The errors associated with sampling at filter face velocities much below the carrying stream velocity (subisokinetic) were further studied. For relatively high approach velocities and when the filter face velocity is only a fraction of isokinetic, larger particles are collected primarily by impaction. Should the air concentration be computed from collected particles and flow volume through the filter, the indicated air concentrations will be much higher than the actual concentration. A relationship was established which permits reasonable estimates of corrections as a function of subisokinetic flow and the approach velocity. The relationship is based upon impaction data obtained for the filter. Data are shown for air velocities from 2.7 to 30 mph and particle sizes from 4 to 21μ. Author

N67-13761# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

ERRORS IN SAMPLING WITH NOZZLES DESIGNED TO ACHIEVE ISOKINETIC FLOW

G. A. Sehmel *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 58–59 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Nozzles were used to obtain isokinetic samples of ZnS particles at air velocities from 5.4 to 30 mi/hr. Particle deposition on the nozzle walls was measured and is reported as the fraction deposited of those entering the nozzle. The deposition increased with particle size and velocity up to 70%. Author

N67-13762# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PARTICLE DEPOSITION AND RE-ENTRAINMENT IN LONG VERTICAL CONDUITS

G. A. Sehmel *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 60–64 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

The deposition of 1- to 10-μ diam particles was measured in vertical, 50-ft long aluminum tubes of 0.52, 1.15, and 2.81 in. I.D. Uraninemethylene blue particles of narrow size range generated with a spinning disc aerosol generator were used. Significant differences from earlier deposition data are believed to be due to the better resolution achieved with the nearly monodisperse particles from the spinning disc. The significantly lower density of the uranine-methylene blue particles than of particles used previously may also contribute to the apparent difference. The deposition ratio, K/V, is shown to be a more complex function of the "reduced stopping distance," S^+, than formerly indicated. Flow conditions which result in significant reentrainment were identified and shown to be consistent with a conclusion that eddy fluctuations penetrate deeply into the laminar sublayer. Author

N67-13787*# National Aeronautics and Space Administration, Washington, D. C.

FACTORS ACTING ON THE BOUNDARY LAYER TRANSITION AT HYPERSONIC SPEED [FACTEURS AGISSANT SUR LA TRANSITION DE LA COUCHE LIMITE AUX VITESSES HYPERSONIQUES]

R. Michel Oct. 1966 15 p refs Transl. into ENGLISH from French Paper No. ICAS-17 Presented at 3d Intern. Congr. in the Aeron. Sci., Stockholm, 27–31 Aug. 1962

(NASA-TT-F-10382) CFSTI: HC $1.00/MF $0.50 CSCL 20D

Preliminary experimental results obtained in a wind tunnel at high Reynolds number and at a Mach number close to 7 are presented and discussed. By visualization and calculation for the boundary layers, the limits of the transition domain for ogives and cylinder-cone configurations of various vertex angles are determined. The variation in the nose angle and thus in the pressure gradients upstream of the body result in a considerable variation of the transition Reynolds number, based on local conditions. The length of the transition region is of the order of the laminar sector, where a considerable thickening of the boundary layer occurs. The apparent friction in the transition domain was found to be much greater than the turbulent friction. Author

N67-13811# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

AN EXPERIMENTAL INVESTIGATION OF AIR FLOW OVER A WAVY PLATE

A. K. Gupta and E. L. Mollo-Christensen Aug. 1966 16 p refs (Contract Nonr-1841(89))

(AD-640189) CFSTI: HC $1.00/MF $0.50

Experiments were carried out with the object of obtaining additional data on the shape of the pressure distribution over a wavelength, the sheltering coefficients, and their relation to Brooke Benjamin's theory. TAB

N67-13834*# National Aeronautics and Space Administration, Washington, D. C.

THE CALCULATION OF FLOW IN A PLANE LAVAL NOZZLE [RASCHETE TECHENIYA V PLOSKOM SOPLE LAVALYA]

Yaj I. Alikhashkin, A. P. Favorskiy, and P. I. Chushkin Dec. 1966 9 p refs Transl. into ENGLISH from Zh. Vychislitel'noy Mat. i Mat. Fiz. (Moscow), v. 3, 1963 p 1130–1134

(NASA-TT-F-10494) CFSTI: HC $1.00/MF $0.50 CSCL 20D

A method of calculation is presented for a potential uniform flow of a perfect gas in the subsonic and transonic part of a plane symmetrical Laval nozzle with a given form of contour. Author

N67-13837*# National Aeronautics and Space Administration, Washington, D. C.

LAWS OF TURBULENT FLOW IN SMOOTH PIPES [GESETZ-MAESSIGKEITEN DER TURBULENTEN STROMUNG IN GLATTEN ROHREN]

J. Nikuradse Oct. 1966 74 p refs Transl. into ENGLISH from VDI (Ver. Deut. Ing.)-Forschungsh. (Duesseldorf), 356, ed. b, v. 3, Sep.–Oct. 1932 p 1–36

(NASA-TT-F-10359) CFSTI: HC $3.00/MF $0.75 CSCL 20D

The laws of turbulent flow in smooth pipes in the widest possible range of Reynolds numbers were determined by means of an experimental setup wherein turbulent water flows in circular pipes could be observed up to Re 3240·10^3. It was shown that the velocity distribution changes with the Re number. Measured velocity distributions and law of drag were compared with v. Karman's distributions and were found to be in good agreement at high Re where the influence of viscosity is absent. If $\lambda = dp/dx\ 2d/\rho u$ is the pipe coefficient of drag, the Blasius drag formula $\lambda/B = 0.316/Re^{1/4}$ is confirmed up to Re = 100·10^3. For higher Ré the drag coefficient becomes $\lambda = 0.0032 + 0.221/Re^{0.237}$. Correlations between the average velocity $\bar{u}$ and maximum velocity U are determined and certain conclusions with reference to the v. Karman drag formula and the present one are drawn. Author

N67-13842 Advisory Group for Aerospace Research and Development, Paris (France).

THE FLUID DYNAMIC ASPECTS OF SPACE FLIGHT, VOLUME ONE

New York, Gordon and Breach Sci. Publishers, 1966 406 p refs Proc. of the AGARD–NATO Specialists' Meeting, Marseille, 20–24 Apr. 1964; Sponsored by the AGARD Fluid Dyn. Panel

(AGARDograph-87, Vol. I)

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N67-13843 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

STATIC AND DYNAMIC BEHAVIOR OF THE LIQUID-VAPOR INTERFACE DURING WEIGHTLESSNESS

E. W. Otto *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 3–38 refs (See N67-13842 04-12)

The problems encountered in attempting to operate systems containing a free liquid-vapor interface in a weightless environment are summarized. The literature reporting the research applicable to or directed toward solutions for these problems is reviewed. Results of the research defining the configuration of the interface as a function of liquid properties and system geometry are discussed. The results of experimental studies of the dynamic behavior of the interface in response to changes in gravity level, to outflow disturbances, and to acceleration disturbances are presented. This study places particular emphasis on determination of the scaling laws that permit prediction of the interface behavior as a function of model size. Author

N67-13844 National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PRELIMINARY ANALYSIS OF LIQUID EQUILIBRIUM CONFIGURATIONS AND DISTURBANCES OF A VEHICLE MOTION DUE TO LIQUID SLOSHING IN SPACE

Donald G. Eide, W. Thomas Blackshear, and Edwin C. Foudriat *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 39–59 refs (See N67-13842 04-12)

The equilibrium free surface of a liquid contained in a tank undergoing simultaneously translational acceleration and a rotation

about an axis fixed with respect to the tank has been investigated. A differential equation which governs the three-dimensional equilibrium free surface has been derived. Solution curves for the two-dimensional form of this equation have been obtained by numerical integration for a region in which the inertial forces acting on the liquid are of the same order of magnitude as the capillary forces. Representative solution curves are presented and discussed for various magnitudes of translational acceleration, rotational rate, liquid to solid contact angle, and vapor volume. The dynamic behavior of a liquid is also investigated for a region where the inertial forces are of the same order of magnitude as the capillary forces. The free-surface frequency is determined and the inertial loading criteria for stable oscillatory motion of the free surface is established. Determination of initial conditions of liquid surface velocity and displacement permits investigation of the angular response of a vehicle to an impulsive torque. The response consists of an average angular velocity and superimposed sinusoidal variation with time. Possible methods of minimizing the sinusoidal variation of the angular motion are presented. Author

N67-13854 ARO, Inc., Arnold Air Force Station, Tenn. Aerospace Environmental Facility.
MODIFICATION OF SUPERSONIC FLOW FIELDS UNDER NEAR SPACE CONDITIONS BY CRYOPUMPING
W. D. Clement, J. A. Collins, Jr., and D. E. Anderson *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 223–244 refs (See N67-13842 04-12)
(Contract AF 40(600)-1000)

Results are presented of a test program designed to simulate an air sampling probe utilizing cryosurfaces cooled to liquid helium temperature to capture the impinging gas. Capture coefficients are given for the liquid helium cooled cryosurface under the conditions of normally directed low density gas flow from a Mach 3 nozzle for both clean, polished surfaces and surfaces coated with a thin film of paraffin. Also presented are the effects of micron-size particles in the gas on the cryopumping capabilities of the cryosurface. Author

N67-13862# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON HYPERSONIC SIMILARITY IN IMPERFECT GAS FLOW AROUND SLENDER BLUNT BODIES OF COMPLEX SHAPE
V. V. Lunev and V. G. Pavlov [1966] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. i Gaza (USSR), no. 4, 1966 p 37–42

The hypersonic similarity laws for flow around blunt bodies are extended to a body with a rough side surface, in particular, to one having angular points (under condition of unseparated supersonic flow). Similarity conditions for a gas imperfect in the whole disturbed region are considered. Author

N67-13988# United Kingdom Atomic Energy Authority, Harwell (England).
PRESSURE-DROP CHARACTERISTICS FOR THE FLOW OF SUBCOOLED WATER AT ATMOSPHERIC PRESSURE IN NARROW HEATED CHANNELS, PART I
R. Forgan and R. H. Whittle May 1966 83 p refs Submitted for Publication
(AERE-M-1739) HMSO: 13s

Measurements were made of the pressure-drop flow characteristics for subcooled water in narrow heated channels, to provide data on subcooled-boiling pressure drop and in particular to locate the minimum in the characteristic curves. The experiments were done on a single channel 24 in. long×1.0 in.×0.127 in. Coolant velocities ranged from 6 to 24 fps and heat fluxes from 82 to 250 watts/cm^2. For this limited range of parameters, it was found that the minimum in the pressure-drop/flow curves always occurred when the temperature rise of the coolant in the channel was 0.8 (saturation temperature at outlet–inlet temperature). Author (NSA)

N67-13982# Westinghouse Corp., Pittsburgh, Pa. Research Labs.
ULTRAHIGH VACUUM TECHNIQUES Semiannual Report, 1 Dec. 1965–31 May 1966
R. Frauenfelder, W. J. Lange, and J. H. Singleton 31 May 1966 47 p refs
(Contract AT(30-1)-2823)
(WERL-2823-21; Rept.-66-9E1-441-R1) CFSTI: HC $3.00/MF $0.50

Two studies are currently being pursued with primary effort on hydrogen permeation through tungsten and secondary effort on the replacement of one adsorbed gas by a second from the gas phase. Significant results have been obtained on the H_2–W problem including some supporting work on the N_2–W and H_2–Mo systems. Author (NSA)

N67-14104*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WEAK LOCALLY HOMOGENEOUS TURBULENCE AND HEAT TRANSFER WITH UNIFORM NORMAL STRAIN
Robert G. Deissler Washington, NASA, Jan. 1967 25 p refs
(NASA-TN-D-3779) CFSTI: HC $1.00/MF $0.50 CSCL 20D

Turbulence and longitudinal heat transfer for an axisymmetric accelerating or decelerating flow were analyzed. The analysis was based on generalized two-point correlation equations, which were obtained from the incompressible Navier–Stokes, continuity, and energy equations. Viscosity, thermal conductivity, and the effects of mean strain were retained in the analysis, but the turbulence was assumed to be weak enough to neglect the triple correlation terms in the equations in comparison with the other terms. The calculated longitudinal turbulent heat transfer in the decelerating case was discussed in connection with the heat transfer at a stagnation point. Author

N67-14109# General Electric Co., Philadelphia, Pa.
LAMINAR INCOMPRESSIBLE LEADING AND TRAILING EDGE FLOWS AND THE NEAR WAKE REAR STAGNATION POINT
Sheldon Weinbaum Paris, AGARD, May 1966 28 p refs Presented at AGARD Specialists' Meeting on "Separated Flows", Rhode-Saint-Genèse, Belgium, 10–13 May 1966; Sponsored by AGARD
(AGARD-526) CFSTI: HC $2.00/MF $0.50

This paper investigates the behavior of a viscous incompressible fluid in the vicinity of various two dimensional separation and stagnation points. Locally valid series solutions to the Navier Stokes vorticity equation are developed to study the pressure-viscous force balance in the neighborhood of the singularity and the transition of the flow region where inertial effects are important. The nature of the singularity is established for an arbitrary symmetric leading or trailing edge and a solution obtained to within an arbitrary constant that depends on the wall shear. The convergence of the series is examined via a term by term comparison with Howarth's exact numerical solution for a two dimensional stagnation point. The solution for the near wake rear stagnation point shows that the wake cannot close in an arbitrary manner, but that the asymptotic direction of the dividing streamline prior to stagnation is a single valued function of the ratio of the velocity on the dividing streamline to that on the wake centerline. Finally, the leading term of a series solution for a blunt based trailing edge is obtained. Upstream influence is neglected, but the zero slip condition on the rear wall is satisfied, and a non-zero separation angle for the dividing streamline is treated for the first time. Author

N67-14114# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
INTRODUCTION TO THE THEORETICAL STUDY OF RESIDUE FLOW [INTRODUCTION A L'ETUDE THEORIQUE DE L'ECOULEMENT DE CULOT]

Lucien Lapine and Henri Viviand Oct. 1966 81 p refs In FRENCH
(Rept.-66-8; Publ.-278) CFSTI: HC $3.00/MF $0.75

The principal theoretical studies are reviewed on base flow downstream of a body moving at supersonic speed in the atmosphere. Emphasis is placed on the pressure of the base heat flux, and on the determination of wake characteristics generated by the displacement of the body. A mathematical model is presented for a unique solution to the base flow problem. Technical details are also given on laminar mixing, the recompression zone, the case of turbulent mixing. Numerous graphs and figures illustrate the experimental data. Transl. by R.Ll.

N67-14115# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
STUDY OF REMOTE LAMINAR SLIPSTREAM. I: TWO-DIMENSIONAL FLOW [ETUDE DU SILLAGE LAMINAIRE LOINTAIN. I: ECOULEMENT BIDIMENSIONNEL]
Henri Viviand Sep. 1966 38 p refs In FRENCH
(Rept.-66-6; Publ.-275) CFSTI: HC $2.00/MF $0.50

The asymptotic expansion of the exact solution for flow in a symmetric, laminar, and compressible wake is considered. Goldstein's expansion, modified by Stewartson by the introduction of logarithmic terms, is extended to the case of compressible wakes with an external pressure gradient. A method is presented for calculating successive approximations, especially applicable for numerical applications beyond the second approximation. This method is used to justify the form of the asymptotic expansion and to calculate the third approximation. The problem of a valid solution in the initial wake region is discussed in detail for the case of a flat plate. Transl. by R.Ll.

N67-14120# European Atomic Energy Community, Ispra (Italy). Scientific Information Processing Center.
COMPUTATION OF THE MOTION OF A LINER UNDER THE IMPACT OF A UNIFORM GAS FLOW
L. Guerri, P. Stella, and A. Taroni Oct. 1966 30 p refs
(EUR-3157.e) CFSTI: HC $2.00/MF $0.50

This problem is treated in plane geometry and represents a simplified model of the motion of an explosively driven liner. The liner-gas interaction gives rise to a shock wave in both the media, and stressed is the shock propagation in the liner. Author

N67-14121# Atomic Energy Establishment, Winfrith (England).
HYDRAULIC STABILITY: AN ANALYSIS OF THE CAUSES OF UNSTABLE FLOW IN PARALLEL CHANNELS
A. L. Davies and R. Potter Apr. 1966 43 p refs
(AEEW-R.446)

The oscillatory instability in a bank of parallel channels is analyzed, based on the equations for conservation of mass, momentum, energy for one-dimensional fluid flow, and the assumption of homogeneous flow in the two-phase region. The equations were linearized, and Laplace transformation is used to develop a set of transfer functions so that the flow problem can be represented as a feedback system. An illustrative example for a once through heat exchanger and the unstable mode produced are discussed. Among the conclusions are: (1) The transfer functions have characteristics capable of producing oscillatory instabilities. (2) Unstable flow is caused by a number of different factors depending on design and operating conditions. N.E.N.

N67-14170# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
SUPERSONIC FLOW OVER FLAPS WITH UNIFORM HEAT TRANSFER
Jean J. Ginoux Sep. 1966 47 p refs
(VKI-TN-30) CFSTI: HC $2.00/MF $0.50

Static pressure, recovery temperature, and heat transfer distributions have been measured on flat plates with flaps at a Mach number of 2.02. A uniform amount of heat was dissipated at the surface of the models. The angle of the flaps was varied between 1.5° and 21°. Laminar, transitional, and turbulent flows were considered. Well defined plateau pressures existed when reattachment was transitional and not in fully laminar flows. A large peak of recovery temperature existed, when transition was in the reattachment zone, followed by fairly low recovery temperatures. Heat transfer results generally agreed with other measurements made with isothermal walls. No peak of heat transfer was detected in the reattachment region. Author

N67-14271# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
VARIOUS REGIMES OF MIXING OF TWO FLUXES WITH DIFFERENT STAGNATION ENTHALPIES [DIVERS REGIMES DE MELANGE DE DEUX FLUX D'ENTHALPIES D'ARRET DIFFERENTES]
Emile Le Grivès and Jean Fabri [1966] 24 p refs In FRENCH; ENGLISH summary Presented at the Intern. Acad. of Astronautics Symp. on Fluid Dyn. of Multiphase Heterogeneous Continuous Media, Naples, 3–5 Oct. 1966 Submitted for Publication
(TP-411) CFSTI: HC $1.00/MF $0.50

In various devices such as turbofans, ram-rockets, induced wind-tunnel ejectors, where mixing processes occur between two flows with highly different total enthalpies, thermal choking may lead to a limitation of the mass flow rate. One-dimensional theory of supersonic ejectors has been applied to the constant area mixing tube; it was shown that a sonic mixed regime can appear beyond the well-known mixed or supersonic regimes. Experimental data on an ejector setup including an arc jet air heater have led to fair agreement with theory. One-dimensional analysis also stands as a first approximation, defining eigen-values of pressure and mass flow rate parameters for computer programs. Author (ESRO)

N67-14303# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
THE CONSTANT-SECTION MIXING OF TWO FLUXES OF DIFFERENT ENTHALPIES [LE MELANGE A SECTION CONSTANTE DE DEUX FLUX D'ENTHALPIES DIFFERENTES]
Jacques Michard [1966] 11 p refs In FRENCH at the Ann. Joint Meeting DGRR/WGLR, Bad-Godesberg, W., Germany, 4–7 Oct. 1966 Submitted for Publication
(TP-410) CFSTI: HC $1.00/MF $0.50

Sonic blocking limiting the mass flow rate of a compressible fluid flowing in a constant-section duct with an external heat input, is considered in the case of the mixing of two fluids of different enthalpies. An experimental rig using an arc-heater provided confirmation of this phenomenon. Author (ESRO)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 28 Space Radiation; and 30 Space Sciences.

N67-13388# Library of Congress, Washington, D. C. Aerospace Technology Div.
MEASUREMENT OF THE ANGULAR AND SPECTRAL DISTRIBUTION OF ATMOSPHERIC INFRARED RADIATION BY THE KOSMOS-45 SATELLITE
Boris Doncov *In its* Foreign Sci. Bull Vol. 2, No. 10 Oct. 1966 p 6–11 refs (See N67-13386 04-34)

A scanning infrared spectrometer system is described which has an angular resolution of 2×10^{-3} radians, covering the spectrum from 0.8 to 38μ with spectral resolution of better than $\pm2\mu$. The

characteristics and operation of the spectrometer and the associated data-recording equipment are given, together with the experimental data on infrared atmospheric radiation and the Earth's albedo collected during one orbit of the Cosmos-45 satellite. Author

N67-13462# Interior Dept., Washington, D. C.
CURRENT AND FUTURE NEEDS FOR REMOTE SENSOR DATA IN ECOLOGY
Stanley A. Cain *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 3–6 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Certain ecological problems of interest to the Bureau of Commercial Fisheries, the Bureau of Sport Fisheries and Wildlife, and the National Park Service are briefly outlined. Affecting the fisheries are problems of: non-random distributions, especially of schooling and commercial fishing fleets; limited coverage by research vessels in relation to vast areas of the oceanic ecosystems; and, evasive behavior toward sampling gear. To this end, the feasibility of underwater cameras and TV, passive acoustic sensors, surface sensors, and lasers from satellites is considered. For an inventory of wildlife populations and migratory movements, the use of sensors at a distance from inches to feet or hundreds of yards is mentioned. Aerial photography observations, implemented by high-resolution remote sensors, are cited as a means to enhance visitor enjoyment and appreciation of the national park system. R.U.

N67-13463# Woods Hole Oceanographic Institution, Mass.
CURRENT AND FUTURE NEEDS FOR REMOTELY SENSED OCEANOGRAPHIC DATA–A SPECULATION
Gifford C. Ewing *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 7–11 refs *Its* Woods Hole Oceanog. Inst. Contrib. no. 1614 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

An estimation on current and future needs and predictions to understand the fundamental oceanographic phenomena is sketched, and the optimization of data acquisition and distribution to investigate such phenomena is proposed. Remote sensing on a global basis to study the unique behavior of a stratified shell of horizontally unbounded liquid on a spinning sphere–the ocean–is stressed. R.U.

N67-13464# Geological Survey, Washington, D. C.
GEOLOGIC APPLICATIONS OF REMOTE SENSORS
William A. Fischer *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 13–19 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

A generalization of problems in geology, geochemistry and geophysics is briefly treated, and the feasibility of sensor application discussed. Guidelines for remote sensor utilization are provided under the trichotomy: the geologic problems to which sensors can be applied, the basis used for sensor selection, and the manner of sensor application. Tabular data are presented for the characteristics and unique qualities of selected sensors, and for environmental variables and estimates of their potential effect on observations of color by various sensors. A graphic estimate (derived from aerial and ground photographs) indicates the size-frequency distribution of macroscopic increments of terrain that vary in color from their surroundings. Also included is a comparison of the unique properties and applications of the camera, colorimeter, and the eye in a color observation system. R.U.

N67-13465# Michigan Univ., Ann Arbor. Dept. of Industrial Health.
NEEDS FOR REMOTE SENSING DATA IN THE FIELD OF AIR AND WATER POLLUTION CONTROL
Paul M. Giever *In its* Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 21–23 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Attention is focused on the need for rapid and accurate evaluation of air and water pollutants, and the optimization of sensing instrumentation and techniques to maintain high quality standards. Application of these techniques is cited for: the evaluation of solids and gaseous pollutants, sulfur dioxide concentrations and the synergistic action of other pollutants in the human body, identification and quantification of atmospheric polynuclear aromatic hydrocarbons, the determination of gaseous and solid pollutants in a stack, and the evaluation of toxic atmospheric dust. Also mentioned are: the desirability of continuous evaluation of chlorine, sulfate or acidity in the area of water pollution, and the need for faster and more accurate laboratory analysis methods of extraction and reaction. R.U.

N67-13466# Geological Survey, Washington, D.C.
REMOTE-SENSOR APPLICATIONS IN HYDROLOGY
Charles J. Robinove *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 25–32 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The feasibility and effective utilization of remote sensing devices for hydrological applications are specified. The assessment of hydrologic phenomena such as water temperature in various contexts including ground-water discharge into surface water, pollution, lake classification, and an estimation of evaporation and transpiration, is related to remote sensing techniques. Along with radar and passive microwave techniques, the prospectives of color photography are mentioned. R.U.

N67-13467# Purdue Univ., Lafayette, Ind. Dept. of Botany and Plant Pathology.
SOME NEEDS FOR EXPANDING AGRICULTURAL REMOTE SENSING RESEARCH
J. Ralph Shay *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 33–36 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The merits of the identification of crop species and of crop damaging agents as a basis for yield forecasts are examined. The approach to agricultural research, as well as data handling and analysis studies emphasize remote sensing, particularly from aircraft or spacecraft, and sophisticated instrumentation. Cost factors and other technical details proposed for the agricultural research program are also listed. R.U.

N67-13468# Kansas Univ., Lawrence. Dept. of Geography and Meteorology.
PRESENT AND FUTURE NEEDS OF REMOTE SENSING IN GEOGRAPHY
David S. Simonett *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 37–47 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50
(Contract NSR-17-004-003)

The problem of interpretation and evaluation of geographical information obtained from the electromagnetic spectrum recorded by existing sensors is examined. The development of specialized instrumentation, together with information requirements and a listing of present needs for remote sensing utilization are highlighted. Specific problem areas emphasized are: the development of hardware and software to encompass multiple alternative routes to automated data handling and manipulation, the development of operational real-time data recall and handling both for research and classroom use, the optimization of all-weather data collection systems, and the development of new instruments for remote sensing based on the use of proxies or surrogates for conventional data. R.U.

N67-13469# Texas Instruments, Inc., Dallas. Geosciences Operations.
COMMENTS ON REMOTE SENSING NEEDS IN GEOSCIENCE ENGINEERING AND EXPLORATION
Jack R. Van Lopik and Lavern A. Yarbrough *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 49–54 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Geoscience engineering requirements for remote sensing instruments are briefly reported. Some areas to benefit from the optimization of valid sensor data acquisition and interpretation are identified as petroleum and minerals exploration, soil type determination, varying data patterns from geologically or pedologically analogous areas, and soils mapping. Details are also given on a soils exploration program. R.U.

N67-13474# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va. Geography Branch.
APPLICATIONS OF AIR AND SPACEBORNE SENSOR IMAGERY FOR THE STUDY OF NATURAL RESOURCES
Roger A. Leestma *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 111–113 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The use of multisensor imagery can revolutionize the portrayal of geographic information. Man can now measure total surfaces of the earth. This concept of totality is being examined and developed and will cover all the fields of geoscience. New methods of photointerpretation combined with comparative studies of imagery from the various remote sensors will advance scientific capabilities and result in more comprehensive knowledge of the earth. Author

N67-13475# Purdue Univ., Lafayette, Ind. Labs. for Agricultural Remote Sensing.
VEGETATIVE, SOIL, AND PHOTOGRAPHIC FACTORS AFFECTING TONE IN AGRICULTURAL REMOTE MULTISPECTRAL SENSING
Roger M. Hoffer, Roger A. Holmes, and J. Ralph Shay *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 115–134 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Current research has as its purpose the identification of crop species and conditions of health and maturity for several economically important crop types in the corn-belt region, using multispectral imagery ranging from 0.3- to 14-μ wavelength and radar imagery. This study has revealed a large number of vegetative variables which often cause marked tonal variations in portions of the electro-magnetic spectrum. Those variables of primary importance are: crop species and variety; relative size and maturity at the time of flight missions; soil type, moisture content, and relative amounts of soil and vegetation observed; and geometric configuration of the crop. Spectrophotometric curves on individual leaves do not always indicate accurately the relative reflectance observed on multispectral imagery. Crop or leaf geometry has a marked influence on reflectance of vegetative canopies, particularly in relation to certain photographic instrumentation variables. It is the purpose of this paper to present certain photographic factors and biophysical reasons that cause remote view spectral tonal variations, together with experimental evidence in support of these reasons. With accurate knowledge of the instrument limitations and biophysical causes of tonal variations over the electro-magnetic spectrum, more precise analysis of multispectral response signatures will be possible, assuring detailed remote sensing a role in agricultural information collection and utilization. Author

N67-13477# Office of Naval Research, Washington, D. C.
MULTISPECTRAL SENSING TESTS AT SOUTH CASCADE GLACIER, WASHINGTON
Robert H. Alexander, Mark F. Meier, and William J. Campbell (Geol. Surv., Takoma, Wash.) *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 145–158 Sponsored by NASA Prepared jointly with Geol. Surv., Takoma, Wash. (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Airborne remote sensing tests were carried out at a glacier in Washington to determine the potential of obtaining glaciological data from earth-orbiting spacecraft. Correlative meteorological and photometric measurements were made on the ground, and detailed glaciological information was available from past studies. Preliminary study of the imagery indicated that the near-infrared is most effective in distinguishing snow from ice and old firn, whereas short wavelength visible light may be better for distinguishing moraine from ice. The thermal infrared experiment was not completely successful, but interesting lake and moraine temperature patterns were detected. Crevassed areas, moraines, and other linear structures show up clearly in radar images, parallel-polarized images being generally superior to cross-polarized ones. Gross textural differences between glacier and land are apparent even when both are covered with a thin snow layer. S.P.

N67-13478# Space-General Corp., El Monte, Calif.
PASSIVE MICROWAVE DETERMINATIONS OF SNOW WETNESS FACTORS
Joseph M. Kennedy and R. T. Sakamoto *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 161–171 refs Sponsored by ONR and AFCRL (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

A mobile field unit, was utilized to measure the microwave radiometric emission characteristics of snow at 13.5 GHz and 37 GHz. Analyses of the data and theoretical considerations show that variations in free water content affect significant changes in the radiometric brightness temperatures of snow. By making measurements with suitable combinations of frequency, polarization, and incidence angles, the free water content of natural snow may be determined. Author

N67-13479# California Univ., Los Angeles.
SOME GEOGRAPHIC APPLICATIONS OF AERIAL INFRARED IMAGERY
John E. Estes *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 173–181 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

This paper, by showing various applications of airborne infrared imagery, is intended to stimulate thinking among geographers toward the potentials of airborne infrared imaging systems as geographic research tools. Examples of the ability of airborne infrared imagery to aid investigations of rural and urban land use, climatology, physiography, resource development, and others are shown. By utilizing the capabilities of airborne infrared systems the researcher will gain valuable supplemental information which in many cases is unattainable from conventional aerial photography. The geographer, in turn, by making use of this tool may be able to aid in infrared systems development. There is still much research to be done on the capabilities and limitations of infrared and the trained geographer can make a significant contribution. At present academic and professional geographers may find it difficult to apply infrared sensors to their research because of the relative expense of the system or the security classification of the imagery. However, as more imagery is declassified and more systems come into use geographers should be prepared to employ this new research tool. Author

N67-13480# Adcole Corp., Waltham, Mass.
REMOTE SENSING OF ICE AND SNOW THICKNESS
M. A. Mayer *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 183–192 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50
(Contract DA-27-021-AMC-26(X))

A high resolution monocycle vhf radar has been developed and tested over lake ice. Tests were conducted using a boom as the antenna support and using a moving helicopter as a support. Ice thickness and snow thickness were readily measured by visual data reduction. Thickness measurement accuracies of the order of 1 cm are possible utilizing this technique. Results of measurements and the data taken are discussed as well as the expected results for such a measurement. The application of these measurements to the determination of dielectric constant is discussed. Author

N67-13481# Goodyear Aerospace Corp., Litchfield Park, Ariz.
INTERPRETING LOCAL GEOLOGY FROM RADAR IMAGERY
Hubert O. Rydstrom *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 193–201 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The intensity of radar return energy, as modified by the factors of radar illumination, surface roughness, and the geometry of objects, is discussed as applicable to local geologic interpretation. The principles involved are described and applied to analyses of local geology in the southwestern United States. Consideration is given to the use of return intensity in conjunction with geomorphic features to obtain a maximum of information. Local geologic interpretations of radar imagery are applicable to military terrain intelligence, natural resources exploration, and planetary exploration. Author

N67-13482# Indiana Geological Survey, Bloomington.
TEMPERATURE VARIATION AT A DEPTH OF 30 CM IN CLAY TILL AND OUTWASH SAND AND GRAVEL
Donald D. Carr and Robert F. Blakely *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 203–214 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The near-surface temperature variation of soils with parent materials of clay till and outwash sand and gravel was investigated with a thermistor probe. Temperatures measured at 30 cm varied considerably within both the soils, so that it was impossible to distinguish between the lithologies by temperature alone. However, diurnal temperature changes were found to be consistently higher in the clay till than in outwash sand and gravel. Study of near-surface soil temperatures above glacial sediments indicates that temperature alone cannot be used to identify the underlying materials. Diurnal differences in near-surface temperatures, however, can be used to distinguish between deposits of clay till and outwash sand and gravel. S.P.

N67-13483# Stanford Univ., Calif. Dept. of Geophysics.
INFRARED SPECTRAL SIGNATURES–A FIELD GEOLOGICAL TOOL
R. J. P. Lyon and Jere W. Patterson (Lockheed Missiles and Space Co., Sunnyvale, Calif.) *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 215–230 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

A continuing evaluation of infrared remote sensing shows that field geology can be performed by using spectral signatures from rocks and soils in the 8 to 13 micron wavelength region. By matching the incoming spectrum with standard curves in the memory of a computer, the bulk composition of the rock surfaces can be established. Real-time evaluation of spectral rates up to 7 per second appear feasible, permitting mapping from mobile vehicles, aircraft and spacecraft. The present equipment consists of a portable grating spectrometer, using a copper-doped liquid-helium cooled germanium detector. Over 1,000 spectral signatures have been obtained in a recently completed program involving operation in rough mountainous and desert field conditions. Advanced rapid-scan equipment being constructed will utilize a spinning filter wheel to secure the spectral rates of 7 per second needed for aircraft and spacecraft operation. Spaceflight applications to terrestrial and lunar problems are discussed. Author

N67-13484# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Photographic Interpretation Research Div.
INFRARED IMAGERY IN THE ARCTIC UNDER DAYLIGHT CONDITIONS
Ambrose O. Poulin and Trevor A. Harwood (Defence Res. Board) *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 231–241 refs Prepared jointly with Defence Res. Board (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Infrared thermal imagery and concurrent aerial photography were obtained from various altitudes over a broad geographical area in Arctic North America and the Polar Basin prior to the start of the melt season. Solar altitudes during the periods of data collection varied from 2 to 27 degrees, and clear weather prevailed most of the time. It was found that some terrain features and conditions depicted in the infrared imagery were not apparent or were only weakly suggested in the conventional aerial photography and that solar irradiation produced both good and bad effects in the thermal imagery. Examples of a few of these findings are presented. Author

N67-13485# Naval Oceanographic Office, Washington, D. C.
THE GROWTH OF OCEAN WIND WAVES AS OBSERVED WITH AN AIRBORNE WAVE PROFILING RADAR
Tim P. Barnett and John C. Wilkerson *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 243–258 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

A section of sea surface subjected to a constant, offshore wind was profiled. From this data, estimates of the "spectrum of encounter" of the sea surface were obtained for a number of different fetch lengths. By solving a singular Fredholm integral equation of the first kind, it was possible to retrieve the true wave spectrum again, as a function of fetch length. Spectral growth curves were obtained and analyzed in light of recent theories of wave generation. The data support the "resonance" theory of wave growth and suggest that wave growth through an instability mechanism is yet to be understood. One of the most significant results of this study was that higher frequency waves grow past or "overshoot" their eventual equilibrium energy value. After "overshooting" they then rapidly decay back to an equilibrium range. Author

N67-13492# Barringer Research, Ltd., Rexdale (Ontario).
THE USE OF MULTI-PARAMETER REMOTE SENSORS AS AN IMPORTANT NEW TOOL FOR MINERAL AND WATER RESOURCE EVALUATION
A. R. Barringer *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 313–325 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The requirement for greatly improved methods of exploration for natural resources is discussed in relation to the expanding demands for raw materials. A new approach is suggested involving the use of multiple remote sensors in aircraft on a regional or national scale in order to assist in the production of high quality geologic maps. Examples are given of the joint use of electromagnetic, magnetic and radiometric airborne survey equipment. The application to water resource problems is demonstrated and the latest advances in airborne pulse electromagnetic equipment are described. Progress is reported on the development of fully instrumented airborne systems with digital readout and computerized data reduction. Author

N67-13496# Colorado State Univ., Fort Collins.
ANISOTROPY OF REFLECTED SOLAR RADIATION FROM VARIOUS SURFACES AS MEASURED WITH AN AIRCRAFT-MOUNTED RADIOMETER

Vincent V. Salomonson *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 393–407 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50
(Contract NASr-147)

The NIMBUS medium resolution radiometer has been mounted on a small aircraft and used to measure the anisotropy of reflected solar radiation from various surfaces. By flying over a surface using a prescribed flight pattern and the scanning characteristics of the radiometer, the variations in the reflected radiation in different directions, radiometer zenith angles, and solar zenith angles have been measured. The results show strong forward scattering over stratus clouds at a large solar zenith angle. Backscattering predominates over a grassland surface at a large solar zenith angle. The ratio of averaged observed reflectance to minimum observed reflectance varies from 1.09 to 1.40 depending on the bandpass and the reflecting surface. Author

N67-13499# Aracon Geophysics Co., Concord, Mass.
SEA SURFACE TEMPERATURE DETERMINATION FROM TIROS SATELLITE DATA
James R. Greaves *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 447–455 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The results of a feasibility study are discussed. Using TIROS VII data it is shown that satellite infrared measurements can be used to determine sea surface temperature gradients. With the addition of at least one conventional measurement, absolute values can be obtained. Methods to circumvent the problem of intervening cloud cover are examined along with the inherent difficulties in using nighttime data. A few case studies are discussed, and suggestions are made as to possible future programs to process large quantities of infrared data on an operational basis. Author

N67-13503# Aracon Geophysics Co., Concord, Mass.
ORBITS, ALTITUDES, VIEWING GEOMETRY, COVERAGE, AND RESOLUTION PERTINENT TO SATELLITE OBSERVATIONS OF THE EARTH AND ITS ATMOSPHERE
William K. Widger, Jr. *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 489–537 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50
(Contract N61339-66-C0031)

The feasibility of using a satellite for remote sensing of the environment is discussed with respect to the influence of the satellite orbit and the viewing geometry, especially as a consequence of the curvature of the earth away from the subsatellite point. Presentation of these two factors includes the concepts of circular orbit velocities, elliptical orbits, circular orbit periods, orbit inclination, the ascending node, effect of earth rotation, subpoint tracks and heading lines, satellite velocities over the earth's surface, and effects of oblateness of the earth. In addition to these considerations the areas of error in geographical location of data, the cross-track scanner, the television camera, and electronic distortions are discussed. S.P.

N67-13507# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Photographic Interpretation Research Div.
TERRAIN INFORMATION FROM HIGH ALTITUDE SIDE-LOOKING RADAR IMAGERY OF AN ARCTIC AREA
Robert D. Leighty *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 575–597 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Radar imagery was obtained at altitudes of 30,000 to 60,000 feet over arctic terrain with the side-looking radar (high altitude) set during two flight programs. Generalities of terrain information retrieval from radar imagery are presented with background information on the regional terrain characteristics in northwest Greenland and discussion of representative project imagery. Author

N67-13509# Kansas Univ., Lawrence.
VEGETATION ANALYSIS WITH RADAR IMAGERY
Stanley A. Morain and David S. Simonett *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 605–622 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50
(Contract NSR-17-004-003)

This paper presents vegetation maps prepared from radar imagery obtained over several climatic environments. The maps and imagery have been compared with each other to determine the types of information extractable, and, where possible, conventional vegetation maps have been employed to aid in the comparison. Emphasis has been placed on the K-band and AN/APQ-56 radar systems. Results indicate that it is normally possible, by means of tonal and textural comparisons combined with basic geographic knowledge of the study area, to: (a) prepare regional or reconnaissance vegetation maps either on the basis of physiognomy or vegetation "type"; (b) delimit vegetation zones as they vary with elevation; (c) trace burn patterns of previous forest fires; (d) delimit altitudinal timber line; and (e) identify species from inference in areas characterized by near monospecific stands. It is anticipated that radar will have a role in the preparation of physiognomic and vegetation type maps particularly in inaccessible or unstudied areas. Author

N67-13510# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
LABORATORY INVESTIGATIONS OF THE GAMMA-RAY SPECTRAL REGION FOR REMOTE DETERMINATION OF SOIL TRAFFICABILITY CONDITIONS
A. N. Williamson *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 623–633 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Gamma radiation from soil samples was measured, and the results were analyzed to evaluate the use of gamma rays in remotely determining soil parameters useful in estimating trafficability. Gamma-ray spectra were obtained from representative samples of sand, silt, and clay placed in a low-background enclosure. Photopeak counting rates and photopeak ratios of thorium, uranium, and potassium were considered in the analysis. Results indicated that photopeak counts of the radio-isotopes of primary interest were proportional to moisture content of the soil samples, but ratios of the photopeaks were nearly independent of moisture content, although different for each soil tested. Gamma-ray measurements were also made on soil samples obtained from all 50 states in an attempt to correlate the ratios of their photopeaks of thorium, uranium, and potassium with soil type and other morphological, genetic, and physical-chemical characteristics of the soils. Author

N67-13511# Naval Oceanographic Office, Washington, D. C.
INFRARED SCANNING THE ARCTIC PACK ICE
R. D. Ketchum, Jr. and W. I. Wittman *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 635–656 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Many miles of coincident infrared scanner imagery and vertical photography were obtained over a large area of the Arctic Basin pack ice between North Ellesmere Island and 87°N and in Baffin Bay. Several overflights at various altitudes were made in this area. The experiment demonstrated that quality sea ice information can be obtained during daylight periods using infrared scanning systems. Incorporating present state-of-the-art instrumentation and imagery interpretation capabilities, the infrared reconnaissance system could be used effectively for identification and mapping of recent zones of ice canopy deformation. Continued airborne experiments and surface environmental studies under varying atmospheric conditions, varying seasons and conditions of light will be necessary to become proficient in translating infrared

data into useable information with high confidence levels. This paper presents illustrations of infrared imagery with coincident visual photography. A discussion of interpretations is presented along with brief mention of applications and limitations of the infrared scanner to sea ice studies. Author

N67-13514# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
EFFECTS OF SOIL LAYERING ON THE USE OF VHF RADIO WAVES FOR REMOTE TERRAIN ANALYSIS
Hansvoerg J. Nikodem *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 691–703 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Laboratory studies have been conducted to determine the effects of soil layering on the quantity of reflected energy measured from terrain. The results of this study indicate that reflections from subsurface interfaces can have a drastic influence on the quantity of energy measured and that standard monochromatic pulsed-radar systems are not suitable for measuring subsurface soil conditions. Systems employing swept-frequency techniques are needed to allow direct measurement of electrical properties of the soils. These properties then can be correlated with the thickness of the upper layer and the moisture content of the soil. Besides soil layers, such factors as soil conductivity and vegetation determine the usable wavelength region. The effects of each of these are discussed and examples of several soil-layering profiles that might be encountered in natural terrain are given. The limits to which the layering profiles of the soils influence the return energy are illustrated. Author

N67-13516# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
ENVIRONMENTAL ANALYSIS, REMOTE SENSING AND EDUCATION
Jack N. Rinker and Robert E. Frost *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 709–711 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The increasing emphasis on environmental analysis and on remote sensing as the instrument for performing this analysis is briefly considered. The various physical, biological, and cultural components of an environment are examined. Professional interest in remote sensing is stated to fall in three categories: (a) design and construction of sensor systems and specialized equipment; (b) systems application to such problems as location of materials for construction, target identification and special detection, and minerals resources inventory; and (c) application of remote sensing by coordination of team efforts. S.P.

N67-13521# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
LOCATION OF ANOMALOUSLY HOT EARTH WITH INFRARED IMAGERY IN YELLOWSTONE NATIONAL PARK
Lee D. Miller *In its* Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 751–769 refs Sponsored by NSF (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Infrared imagery of Yellowstone National Park was used on the ground in the Park to locate several anomalously hot earth areas. The areas sought out were manifested at the surface only as hot earth, and not as hot water or steam. Only one of the approximately dozen such areas encountered had been previously specifically noted by individuals frequenting these areas. Interactions between the anomalously hot earth and the surrounding vegetation including tree cover will also be noted. Author

N67-13523# Barringer Research, Ltd., Rexdale (Ontario).
PROGRESS IN THE REMOTE SENSING OF VAPOURS FOR AIR POLLUTION, GEOLOGIC AND OCEANOGRAPHIC APPLICATIONS
A. R. Barringer and J. P. Schock *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 779–791 ref (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Extensive applications exist for sensitive equipment capable of detecting a range of gases and vapors from survey aircraft and orbiting spacecraft. Air pollution is becoming an increasingly serious problem and survey systems for monitoring concentrations and the dynamics of dispersion are important requirements. New possibilities exist for applying vapor detection to various geologic exploration problems and also to oceanographic studies of the surface distribution of marine life. Instrumentation is described which is capable of remotely sensing vapor concentrations in the part per billion range. The equipment utilizes dispersive optics in conjunction with special correlation masks matched to the appropriate spectra, and a single unit can be programmed to detect a number of gases. Potential orbital applications for the geochemical study of planetary atmospheres are discussed. Author

N67-13524# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
RADIO ICE-SOUNDING TECHNIQUES
Jack N. Rinker, S. Evans, and G. de Q. Robin (Scott Polar Res. Inst.) *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 793–800 refs Prepared jointly with Scott Polar Res. Inst. (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

During the summer of 1964 a cooperative research project team traversed some 450 miles of the Greenland Ice Cap to evaluate two vhf band radar systems for measuring ice thickness and contouring the bedrock profile at the ice/rock interface. A continuous radar trace of the bedrock was obtained for some 450 miles of traverse and through ice thicknesses of 4600 feet. Author

N67-13525# Agricultural Research Service, Weslaco, Tex. Southern Plains Branch.
REMOTE SENSING IN SOIL AND WATER CONSERVATION RESEARCH
Victor I. Myers, C. L. Wiegand, M. D. Heilman, and James R. Thomas *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 801–813 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

This paper describes the application of remote sensing to certain soil and water problems. Spectrophotometry as applied to agricultural and desert vegetation is discussed. Spectrophotometer curves serve mainly to establish the pure optical phenomena of plants unaffected by extraneous conditions. It is important to recognize that other factors such as crop geometry and background soil conditions influence the signal from vegetated areas. An example of the relationships is presented. The use of various crops as indicator plants for detailed detection of subsoil moisture and salinity conditions, using Kodak Ektachrome infrared aerial film is described. The measurement of plant-leaf temperatures as a method for studying energy budgets of agricultural areas, for estimating soil moisture, and for detecting the occurrence and extent of soil salinity is discussed. The potential of multispectral remote sensing for soil surveys is discussed. Certain past limitations in the application of color aerial photography to soil surveying may be surmounted using microwaves, low-frequency radar, infrared thermometry, and sensing in other portions of the electromagnetic spectrum. Author

N67-13526# Woods Hole Oceanographic Institution, Mass.
PRECISE AIRBORNE RADIATION THERMOMETRY
Peter M. Saunders and Charles H. Wilkins *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 815–826 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50
(Grant Nonr(G)-2196-00)

Measurements with radiation thermometers suffer from the imperfect transparency of atmospheric windows and the non-blackness of the surface. By vertical sounding the importance of atmospheric absorption and emission can be estimated: effects of up to 1°C arise at altitudes of only 1000 ft. Estimates of the energy reflected from the ocean have been made employing a statistical description of the slopes on its surface. It is shown that in the 8–12μ window sun glitter is unimportant and that except for a near horizon strip sky radiation reflected from its surface does not change appreciably with roughness. A normal-oblique method for interrogation of the sea surface is proposed which yields directly the magnitude of the absorption-emission and reflected energy corrections from flight level. Author

N67-13627# Geological Survey, Washington, D. C.
INFRARED SURVEYS AT TAAL VOLCANO, PHILIPPINES
R. M. Moxham and Arturo Alcaraz (Natl. Res. Council, Manila) *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 827–843 refs Prepared jointly with Natl. Res. Council, Manila (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

After being dormant for 54 years, Taal Volcano erupted violently on September 28, 1965. An elongate, southwest-trending explosion crater formed on the southwest flank of the volcano. The water of Lake Taal, which surrounds the volcanic island, flowed into the explosion crater, forming a narrow inlet. Infrared scanner (8–14 micron) surveys, made about two weeks after eruption ceased, show relatively little thermal activity on the southern part of the island, except for the high temperatures of water issuing from the new cinder cone at the head of the inlet. Two other principal areas of abnormal thermal activity were defined: (a) a fumarole area which has been active for many years on the north flank of the volcano's main (1911) crater, and anomalies around the summit and on the southeast flank of Mt. Binintiang Malaqui on the northwest tip of the island. Historical records indicate Mt. Binintiang Malaqui last erupted in 1707. Though some hot springs and fumaroles were previously known here, the infrared surveys indicate the thermal activity at this crater may be more widespread than previously supposed. No thermal evidence of a postulated southwest-trending rift zone across the island was found. Author

N67-13528# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Photographic Interpretation Research Div.
HIGH ALTITUDE, SIDE-LOOKING RADAR IMAGES OF SEA ICE IN THE ARCTIC
V. H. Anderson *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 845–857 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

High altitude, side-looking radar was used to image sea ice patterns between Greenland and Ellesmere Island and within the Arctic Ocean, during the spring of 1962. Concurrent low altitude visual reconnaissance of sea ice patterns was conducted by the author over much of the same flight path flown by the radar aircraft. A comparison of the radar patterns with actual observed and photographed sea ice conditions is presented in this paper. A dramatic example of the eroding processes of polar ice as it moves southward to warmer environments is displayed by the radar imagery and is discussed in this paper. An example of radar imagery of sea ice in the Arctic Ocean, existing under a deteriorating environment during the summer of 1962, is also presented. Included is the radar image of Ice Island "T3" in the Beaufort Sea north of Alaska. Author

N67-13541*# Consultants and Designers, Inc., Arlington, Va.
ON ONE OF THE POSSIBLE FORMATION MECHANISMS OF NARROW SPORADIC IONOSPHERE LAYERS [OB ODNOM IZ VOZMOZHNYKH MEKHANIZMOV OBRAZOVANIYA UZKIKH SPORADICHESKIKH SLOYEV IONOSFERY]
G. S. Ivanov-Kholodnyy and V. I. Lazarev 7 Jun. 1966 7 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 2, 1966 p 397–399
(Contract NAS5-9299)
(NASA-CR-80659; ST-AI-10499) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The electron concentration, and sounding rocket studies of the ionospheric E-layer are presented. Tabular data record height, width, and electron concentration, as well as electron calculation with energy E=100 and 30 KeV for geomagnetic latitude ~45° at 110 km altitude. It is stated that the frequency increase of in with the rise of geomagnetic latitude, and its relation to geomagnetic activity indicate that the sporadic type E_s ionization may be induced by a flux of charged particles E_s the atmosphere. The assumption of the existence at 100–1000 km heights of fluxes of trapped electrons with close pitch-angle values permits overcoming one of the essential difficulties in explaining sporadic layers, i.e., the explanation of the small thickness and of a great electron concentration gradient. The proposed mechanism agrees well also with the representation about the floccular or cloudy structure of E_s R.U.

N67-13642# United Kingdom Atomic Energy Authority, Dounreay (Scotland). Health and Safety Dept.
TISSUE DOSE-EQUIVALENT RATES. I: FROM COSMIC RAY NEUTRONS. II: IN THE LOW LEVEL ENVIRONMENT OF CHAPELCROS NUCLEAR POWER STATION
D. E. Watt, D. M. Clare, and A. R. B. Gordon 1966 15 p refs
(PG-734(CC)) HMSO: 2s 6d

On the basis of published data from cosmic ray studies, the dose-equivalent rate due to naturally occurring neutron radiation is calculated to be 11.8±1.0 mrem/y for a small piece of tissue in air at sea level and at a location with geographical coordinates (lat. 55°2'N, long 3°21'W). It is deduced that the neutron dose equivalent experienced by the population at sea level for isotropic irradiation varies from 6.2±0.5 mrem/y at the surface of the body to 58% of this value at 10 cm deep assuming the body is represented by a semi-infinite slab of tissue 20 cm thick. The D.E. rate at the surface of the body for persons flying at supersonic transport altitudes (≈65,000 ft) is 0.20±0.02 mrem/hour. Experimental measurements, using the spherical moderator technique, confirm the calculated value for the natural dose-equivalent rate. These measurements were extended to determine contours of dose-equivalence in the low level environment of the reactor installation. Author

N67-13561# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
POLARIZED EMISSIVITY OF WATER WITH AND WITHOUT SUPERIMPOSED ICE SHEETS
V. Sirounian Oct. 1966 31 p refs
(DAC-59055)

Numerical computations are performed for polarized emissivity of a smooth oceanic surface for various zenith angles of observation in the 0.1 to 10 cm region of the microwave spectrum. It is noticed that the polarized emissivity depends on the zenith angle of observation, water temperature, and wavelength of the microwave radiation. The polarization increases with the increase of the zenith angle of observation, and has a maximum which shifts toward larger angles for the longer wavelengths. The temperature dependence of the polarized emissivity is especially strong in the region of 0.2 to 2 cm and large zenith angles of observation. It is determined that there is a considerable change in the emissivity when a thin ice layer is present for the wavelengths of the microwave radiation in the order of ice thickness. The oceanic polarized emission for possible determination of unique surface temperatures is analyzed. The effect of ground surface reflectivity, and the sun's microwave radiation effect on reflected radiation are discussed. Author

N67-13574*# Consultants and Designers Inc., Arlington, Va.
IONIZATION OF THE E-LAYER AND X-RAY EMISSION OF THE SUN IN THE 44–60 Å BAND [IONIZATSIYA SLOYA E I RENTGENOVOYE IZLUCHENIYE SOLNTSA V DIAPAZONE 44–60 Å]
V. Letfus and K. Serafimov 8 Jun. 1966 9 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 2, 1966 p 352–356
(Contract NAS5-9299)
(NASA-CR-80686; ST-AI-SP-10500) CFSTI: HC $1.00/MF $0.50 CSCL 04A

A method of correcting the computation of the characteristic number J_E, taking into account the possible seasonal variations, is discussed, along with the best correlation between J_E and the various possible ionizing agents. Emphasis is placed on the pre-noon lag in the rise of the critical frequencies. An example is presented taking the data of the quiet sun for the year 1964, and the characteristic numbers obtained were found to correspond well with the intensity of the solar X-ray emission in the 44–60 Å band. N.E.N.

N67-13577*# Volt Technical Corp., Washington, D. C.
ANOMALOUS COMPOSITION OF FORMING IONS AND CERTAIN EVENTS IN THE LOWER IONOSPHERE [ANOMALIYA SOSTAVA OBRAZUYUSHCHIKHSYA IONOV I NEKOTORYYE YAVLENIYA V NIZHNEY IONOSPHERE]
G. S. Ivanov-Kholodnyy 1 Dec. 1966 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 4, 1966 p 831–834
(Contract NAS5-12487)
(NASA-CR-80683; ST-AI-10542) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The variations of the NO^+–O_2^+ ratio, and the effective recombination coefficient are discussed. The relative composition of primary ions O^+, O_2^+, and N_2^+ was determined, and the results are graphed. The variation of the relative rate of ion formation with the altitude is described. Calculations for low and high solar activity show an anomalous variation of the ion formation. It is shown that as the zenith angle increases, or the solar activity decreases, the electron concentration decreases. The variation of the effective recombination coefficient as a function of the altitude of zenith angle and of the solar activity level is indicated. N.E.N.

N67-13580*# Volt Technical Corp., Washington, D. C.
ONCE MORE ABOUT THE POSSIBILITY OF DETERMINING THE LOCAL ELECTRON CONCENTRATION BY THE DISPERSION METHOD WITH THE HELP OF AES AND ON NEW IONIZATION MAXIMA IN THE IONOSPHERE [YESHCHE RAZ O VOZMOZHNOSTI OPREDELENIYA LOKAL'NOY KONTSENTRATSII ELEKTRONOV V IONOSFERE DISPERSIONNYM METODOM PRI POMOSHCHI ISZ I O NOVYKH MAKSIMUMAKH IONIZATSII V IONOSFERE]
K. I. Gringauz, Yu. A. Kravtsov, V. A. Rudakov, and S. M. Rytov 20 Oct. 1966 15 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 3, 1966 p 568–580
(Contract NAS5-12487)
(NASA-CR-80680; ST-PF-AI-10525) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The dispersion method as applied to satellites, and the interpretation of the data so obtained are discussed. The influence of horizontal gradients and of nonstationary state of the ionosphere, and the errors in electron concentration determination are described. It is pointed out that the dispersion method is satisfactory for rockets, but not for satellites. Details are given on the interpretation of data, and on the comparison of data obtained by different methods. It is concluded that the precision of electron concentration determination using the dispersion method and coherent radiowaves emitted from the satellite is low, due to the horizontal gradients and the nonstationary ionospheric state. N.E.N.

N67-13608*# RAND Corp., Santa Monica, Calif.
WESTWARD DRIFT OF THE GEOMAGNETIC FIELD AND ITS RELATION TO MOTIONS OF THE EARTH'S CORE
A. D. Richmond Dec. 1966 20 p refs
(Contract NASr-21)
(NASA-CR-80712; RM-5191-NASA) CFSTI: HC $1.00/MF $0.50 CSCL 08N

The rate of westward drift of the geomagnetic field for epoch 1960 is calculated by use of the method of a least-square fit. The drifts of the magnetic potential and of the radial magnetic field are calculated at the surface of the earth and at the surface of the earth's fluid core, and the discrepancies between the different values obtained are explained. It is shown that the value for the drift of the radial magnetic field at the earth's core (.155°/yr westward) should provide the best estimate of the drift of the fluid at the surface of the core. Author

N67-13620# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
GENERAL LORENTZ CONDITIONS FOR A SPHERICALLY SYMMETRIC GRAVITATIONAL FIELD
Ya. I. Pugachev 10 Aug. 1966 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 1, 1964 p 76–80
(Contract NOw-62-0604-c)
(TG-230-T495)

Generally covariant supplementary conditions (generalized Lorentz conditions) in spherical coordinates, as applied to the Schwarzschild problem, are analyzed in this article. It is found that the limits imposed on the metric in the known Schwarzschild solution correspond to the tensor conditions of Einstein and do not correspond to the generalized harmonic conditions of De Donder–Fock. Author

N67-13635# Los Alamos Scientific Lab., N. Mex.
BETA-GAMMA RADIOACTIVITY IN ENVIRONMENTAL AIR AT LOS ALAMOS, NEW MEXICO, FOR 1965
W. R. Kennedy and Jack W. Aeby 11 Jul. 1966 22 p
(Contract W-7405-ENG-36)
(LA-3516-MS) CFSTI: $2.00

The radioactivity in samples of atmosphere particulates and precipitation was measured in samples collected daily during 1965. Levels of radioactivity declined throughout the year. No fallout which could be attributed to atmospheric testing was detected. NSA

N67-13700*# Geological Survey, Washington, D. C.
MEASUREMENT OF LUMINESCENCE BY THE FRAUNHOFER LINE DEPTH METHOD
H. T. Betz (IIT Res. Inst., Chicago) Dec. 1966 21 p refs *Its* Tech. Letter NASA-70
(NASA Order R-146)
(NASA-CR-80487; IITRI-W6137-3) CFSTI: HC $1.00/MF $0.50 CSCL 08B

To define problems associated with detecting solar stimulated luminescence of natural materials, experiments were conducted in which a grating spectrometer was used to detect the luminescence of minerals exposed to the sun. The tests were conducted on three samples: calcite, colemanite, and phosphate rock. The line depth method is described, and data are given on the Fraunhofer lines in the near ultraviolet and visible regions of the spectrum which are suitable for observation by this method. The optical system used in the line profile measurements is also described, and shown schematically. The H-line profiles recorded for each sample and solar reference are plotted. Although instrumentation and atmospheric conditions were not ideal, it was concluded that the measurements indicate the feasibility of using the technique. M.G.J.

N67-13714# National Physical Lab., New Delhi (India).
ROCKET-BORNE RIOMETER AS A TECHNIQUE FOR D-REGION STUDY
Y. V. Somayajulu and A. P. Mitra 1 Aug. 1966 13 p refs
(RPU-529) CFSTI: HC $1.00/MF $0.50

In principle, the rocket-borne riometer in its flight through the D-region, measures change in absorption of the cosmic noise as a function of altitude. From this absorption change versus height profile, the electron density distribution in the D-region can be derived. Theoretical and system considerations are out-lined to demonstrate the feasibility of this technique. It is shown that this technique is particularly suited to measure the electron density distribution below 75 km where reliable data are most needed. The advantages of this method and its potential applications to interpret the ground-based riometer absorption data are discussed.
Author

N67-13726*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
[ANALYSIS OF SATELLITE DATA FOR STUDIES RELATED TO IONOSPHERIC PLASMA RESEARCH] Semiannual Status Report, Apr. 1–Sep. 30, 1966
30 Sep. 1966 6 p refs
(Grant NGR-21-002-060)
(NASA-CR-80741) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Some specific investigations being conducted under a research program concerned with the general area of the ionospheric plasma are briefly discussed. These deal with the use of cylindrical Langmuir probes onboard the Explorer XVII and XXII satellites to study the ionospheric plasma, and the interaction of spacecraft with the ionospheric plasma.
R.N.A.

N67-13741# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1965 IN THE PHYSICAL SCIENCES. VOLUME 3: EARTH SCIENCES
D. W. Pearce and J. K. Green, ed. May 1966 101 p refs
(Contract AT(45-1)-1830)
(BNWL-235-3) CFSTI: HC $3.00/MF $0.75

Papers are presented concerning the areas of geology and hydrology, mineral chemistry, and particles and gases. The papers cover such topics as variations in the earth's gravity field, ground water flow characteristics, soil radioactivity, and the sampling of particles in an air stream. For individual titles see N67-13742–N67-13764.
Author

N67-13742# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE STRATIGRAPHY OF THE UPPERMOST PART OF THE BASALT SEQUENCE AND ITS IMPLICATIONS
R. E. Brown *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 1–4 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

The stratigraphy of the basalt sequence was carried beneath the Hanford area to a depth of 1000 ft. Region-wide data then further confirmed two Oregon sources of the basalt flows. Diversion and ponding of the Columbia River by flows encroaching on it from the southeast were important in the deposition of beds of the Beverly Member of the Ellensburg Formation. Anticlinal ridges began to rise at various times to affect the Columbia River course, the deposition of its sediments, and the extent of the basalt flows. Knowledge of the stratigraphy permits determination of the hydrologic characteristics of the basalt sequence and of individual aquifers. The feasibility of disposal or storage of wastes with maximum safety in the basalt can, in turn, be better appraised.
Author

N67-13743# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
VARIATIONS IN THE EARTH'S GRAVITY FIELD AT HANFORD
D. E. Peterson *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 4–6 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

Several hundred measurements of the acceleration of gravity were made to determine the nature of the gravity field in the Hanford area. Observed values range from 980.4786 cm/sec^2 at the point of highest altitude in the Rattlesnake Hills, to 980.7120 cm/sec^2 at the horn of the Columbia River. Bouguer anomalies reduced from the observed values are being correlated with geologic information, including depth to basalt, to obtain a more complete picture of the geologic environment at Hanford. In 1965, dense basalt was encountered by a drill approximately 170 ft above the depth at which basalt normally occurs in section 2 of T12N, R26E. Gravity observations compared with gravity values from a theoretical model of a basalt high indicate that a field of large boulders is the probable explanation for the anomalous basalt.
Author

N67-13744# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PREDICTION OF VERTICAL INFILTRATION AS INFLUENCED BY ERRORS IN MEASURING CAPILLARY PRESSURE
L. G. King *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 7–10 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

The soil characteristics, permeability, capillary pressure, and saturation, measured during steady flow or equilibrium conditions were used to solve the one-dimensional, transient boundary-value problems for vertically downward flow during infiltration. The calculated results were compared with experimental data from actual transient flow columns. Predicted and experimental results agreed very well after the capillary pressure values of the measured permeability and capillary pressure relationship were corrected for manometer errors.
Author

N67-13745# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
HORIZONTAL INFILTRATION OF LIQUIDS INTO POROUS SOLIDS
L. G. King *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 10–13 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

The diffusivity functions computed from steady flow and equilibrium measurements of permeability, capillary pressure, and saturation were used to solve the one-dimensional, transient boundary value problems for horizontal flow during infiltration. Strictly linear flow in the horizontal direction cannot occur even for samples which are quite thin in the vertical direction. In the actual physical system, vertical components of flow do exist. The importance of the vertical components is greater for coarse-textured soils than for fine-textured soils.
Author

N67-13746# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
"STREAM", A GENERAL ROUTINE FOR GETTING STEADY GROUND WATER FLOW PATHS AND TRAVEL TIMES
R. W. Nelson *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 14 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

A computer program is briefly described which uses the equations derived previously for streamlines in heterogeneous media

to provide useful results for waste transport analysis. The program generates paths of flow, determines the permeability along each path, gives the associated travel times for a very wide class of flow problems in porous media. Tests of the accuracy of the numerical results have indicated that very satisfactory answers are obtained with the programs. Author

N67-13747# Battelle-Northwest, Richland Wash. Pacific Northwest Lab.

EXTENSION OF SOLUTION CAPABILITIES BY FINITE DIFFERENCES METHOD TO A LARGE CLASS OF STEADY-STATE FLOW PROBLEMS

A. E. Reisenauer *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 15–17 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

The computer program, Steady Darican Flow in Soils, has been enlarged and extended to include capabilities for solving a large class of flow problems. These new features include a variable mesh size for the finite differences expression, a flux input independently controlled at every node, an enlarged number of node points, and the ability, in partially saturated soil, to vary the capillary conductivity completely by inputing soil type curves and varying the base permeability of the soil at any node. Author

N67-13748# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

A THEORETICAL BASIS FOR USING ONLY THE PRESENT ENERGY DISSIPATION PATTERN TO PREDICT NEW GROUND WATER POTENTIAL DISTRIBUTION IN HETEROGENEOUS POROUS MEDIA

R. W. Nelson *In its* Pacific Northwest Lab. Ann. Rept. for 1965 in the Phys. Sci. Vol. 3 May 1966 p 17–18 (See N67-13741 04-13) CFSTI: HC $3.00/MF $0.75

An equation is presented which includes the effects of nonhomogeneous soils on new potential distributions without directly solving for the soil permeability distribution. In situations where the travel times or fluxes are not required to answer the problem at hand, then considerable economy in computational effort is brought about through use of the equations derived here. Author

N67-13797*# National Aeronautics and Space Administration, Washington, D. C.

ON CHEMICAL FRACTIONATION IN THE SILICATE PHASE OF METEORITES [O KHIMICHESKOM FRAKTSIONIROVANII V SILIKATNOY FAZE METEORITOV]

A. A. Yavnel' Nov. 1966 15 p *refs* Transl. into ENGLISH from Geokhimiya (Moscow), no. 3, 1966 p 291–298
(NASA-TT-F-10416) CFSTI: HC $1.00/MF $0.50 CSCL 08D

The content of lithophylic elements in stony and stony-iron meteorites of various types was investigated. The chondrites are divided into three branches—enstatite, ordinary, and carbonaceous, with a varying content of both the total iron and its forms, and the relative nickel content. It is evident from the data that there is a direct connection between the groups within each branch of chondrites. As regards the content of most of the elements, ordinary chondrites lie between enstatite and carbonaceous chondrites. No conclusion can be drawn as to the process of transition from one branch of chondrites to the other. Author

N67-13809# Radio and Space Research Station, Slough (England).

ATMOSPHERIC WINDS BETWEEN 100 AND 700 KM AND THEIR EFFECTS ON THE IONOSPHERE

H. Kohl (Max-Planck-Institut fuer Aeronomie) and J. W. King [1966] 29 p refs
CFSTI: HC $2.00/MF $0.50

The global wind system produced at different local times by pressure gradients in the upper atmosphere has been calculated using data from Jacchia's model atmosphere. The horizontal wind velocities vary with height, and are of the order of 100 m sec^{-1} at about 300 km; they depend on ion drag, viscosity and Coriolis forces, but the major importance of ion drag as a force determining the form of the atmospheric wind system has been demonstrated. The various limitations of and approximations made in the present calculations have been discussed in detail. The global atmospheric wind system produces important vertical ionospheric drifts, and it has been suggested that these may readily explain many anomalous ionospheric observations including the midday bite-out, some features of the maintenance of the night-time ionosphere, and the universal time effects observed in the high latitude ionosphere. It has also been suggested that various neutral atmosphere phenomena, such as the observed eastwards rotation of the atmosphere, may also be a consequence of the wind system. Author

N67-13813# National Physical Lab., New Delhi (India). Radio Propagation Unit.

SOLAR AND GEOPHYSICAL DATA, PART 2

Aug. 1966 20 p
(RRC-A-134, Pt. 2; SG-7) CFSTI: HC $1.00/MF $0.50

Presented are solar and geophysical data obtained by vertical incidence sounding technique for Indian stations during July, 1966. Observed were: solar indices, solar flares, solar radio emission, magnetic flare effects, magnetic storms, ionospheric effects of solar flares, and recordings of SID events. G.G.

N67-13869# High Altitude Observatory, Boulder, Colo.

OBSERVATIONS OF JUPITER'S SPORADIC RADIO EMISSION IN THE RANGE 7.6-41 MHz, 1 JUNE 1965–5 JULY 1966

James W. Warwick and George A. Dulk (Colorado Univ., Boulder) 1 Nov. 1966 75 p IGY Solar Activity Rept. Ser., No. 34

Decametric emissions are listed through the Jupiter apparation of 1965. Plots of emissions and observations for the apparations of 1962 through 1965 and histograms of emission probability are also presented. A.G.O.

N67-13920# Central Lab. for Radiological Protection, Warsaw (Poland).

OBSERVATION OF THE GAMMA-RAY BACKGROUND IN WARSAW WITH A SCINTILLATION STATIC MONITOR [WYNIKI OBSERWACJI TLA PROMIENIOWANIA GAMMA W WARSZAWIE PRZY ZASTOSOWANIU METODY SCYNTYLACYJNEJ]

J. Pensko 1966 21 p refs
(CLOR-50/D) CFSTI: HC $1.00/MF $0.50

The systematic observations of gamma background dose rates were carried out during the years 1962–1965 in Warsaw. The measurements were performed by means of scintillation counter NaI/Tl/2-1/4"x2". The dose rate is greater in summer than in winter. The rain-showers bring the temporary increase of gamma background, sometimes to about 80 per cent of the mean value. The dose rate from fission products amounted to about 25 per cent of natural background radiation in the autumn 1962, to about 70 per cent in the summer 1963, and to about 39 per cent in the summer 1964. The contribution to gamma background radiation from radon daughters contained in the atmosphere amounted to about 1.8 per cent in the summer 1964, and to about 5.5 per cent in the autumn and winter 1964/65. Author

N67-14122# Weapons Research Establishment, Salisbury (Australia).
A COMPUTER PROGRAMME TO ASSIST IN THE REDUCTION OF SATELLITE IONOSPHERIC OBSERVATIONS
J. B. Haseler and D. G. Singleton Jul. 1966 25 p refs
(APD-4) CFSTI: HC $1.00/MF $0.50

The availability of satellite scintillation data obtained by the simultaneous observation of the Beacon Explorer satellites at a number of sites throughout Australasia, makes it possible to study the spatial morphology of the F-layer irregularity patches believed to be responsible for the scintillations. A computer program is described which produces annotated data for further analysis, together with a convenient cartographic display of the data. The maps so produced may provide useful data on the geographical distribution. The program outputs the annotated data on magnetic tape in binary or in B.C.D. form so that it may be subjected to more detailed analysis. Author

N67-14135# Travelers Research Center, Inc., Hartford, Conn.
PARTICLE FALLOUT AND DISPERSION IN THE ATMOSPHERE Quarterly Report No. 3
K. D. Hage, P. S. Brown, G. Arnason, and N. E. Bowne Apr. 1966 70 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-66-2030) CFSTI: HC $3.00/MF $0.75

Progress is described on the development of a three-dimensional model (Model B) for estimating the transport and dispersion of falling particles released from an instantaneous point or line source located at altitudes of 10 to 90 km. The Runge–Kutta–Gill fourth-order numerical method was found to be fast, accurate, and stable for the integration of particle trajectories, and was selected for the use in the model. The minimum time-step length needed for specified absolute accuracy of particle position depends on the amplitude and wavelength of disturbances in the wind field. These relationships were investigated for floating particles in a large-scale, stationary wind field. Vertical profiles and maps of total stream function illustrate the mathematical functions that are used to simulate the mean wind flow and the planetary or long-wave velocity components. The equations that are used for the simulation of short-wave wind velocity components are described. Draft specifications and flow diagrams for the Model B computer program are given in an appendix. Author (NSA)

N67-14149# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 145
5 Dec. 1966 147 p refs
(JPRS-38937; TT-61-11147-145)

News items and abstracts of scientific articles are presented, which summarize various aspects of Sino-Soviet research in the fields of astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space research. Complete bibliographic information is supplied for each article. L.E.W.

N67-14159# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 146
19 Dec. 1966 76 p refs
(JPRS-39180; TT-61-11147-146) CFSTI: $3.00

Various Sino-Soviet publications in the fields of astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space research are presented in the form of abstracts, summaries, and occasional full translations of articles. Complete bibliographic information is given for each article. L.E.W.

N67-14172# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR JUNE 1966 FROM SALISBURY, SOUTH AUSTRALIA
Jul. 1966 21 p
(WRE-CPD-1966/6(S)) CFSTI: HC $1.00/MF $0.50

Hourly values of the customary ionospheric parameters are tabulated for the station at Salisbury, South Australia. These data include values for f_0E_s, f_0E_s, f_0E, f_0F_1, f_0F_2, f_{min}, $h'E_s$, $h'E$, $h'F$, and $M(3000)F_2$. C.T.C.

N67-14179# Queens Univ., Belfast (Northern Ireland).
ATMOSPHERIC HYDROGEN
D. R. Bates and M. Nicolet (Inst. d'Aeronomie Spatiale de Belg.) [1965] 14 p refs
(Contract AF 61(052)-780)
(AFCRL-65-569; SR-4; AD-619826) CFSTI: HC $1.00/MF $0.50

Attention is drawn to the possibility that $H + HO_2$ yielding $H_2 + O_2$ may be an important source of hydrogen molecules in the lower thermosphere. It is suggested that the fractional volume abundance of hydrogen atoms (free and combined) in this region is determined by, and is not very much less than, the corresponding fractional volume abundance in the stratosphere. Any hydrogen molecules in the lower thermosphere would affect the altitude distribution of hydrogen atoms and augment their rate of escape. Author (TAB)

N67-14205*# IIT Research Inst., Chicago, Ill.
AN AIRBORNE EXPERIMENT TO DETERMINE TEMPERATURE VARIATIONS THROUGHOUT THE SOLAR CORONA DURING THE ECLIPSE OF 12 NOVEMBER 1966 Quarterly Status Report, 1 Oct.–31 Dec. 1966
Gordon Henderson 19 Dec. 1966 12 p
(Contract NASr-65)
(NASA-CR-80838; IITRI-A6122; QSR-3) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The work carried out during this period has been devoted to the installation of the equipment in the NASA Convair 990, "Galileo", the checking out of the equipment in flight under simulated eclipse conditions, the staging of the eclipse expedition and the performance of the eclipse observation, and the commencement of the data analysis. Author

N67-14221*# Israel Program for Scientific Translations, Ltd., Jerusalem.
GEOPHYSICAL BULLETIN, NO. 13
A. Kh. Khrgian, ed. 1966 169 p refs Transl. into ENGLISH of Geofiz. Byul. (Moscow), no. 13, 1963 Published for NASA and NSF
(NASA-TT-F-283; TT-65-50117) CFSTI: HC $4.00/MF $1.00 CSCL 08C

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N67-14222*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PRINCIPAL SCIENTIFIC PROBLEMS FOR THE INTERNATIONAL YEARS OF THE QUIET SUN

N. V. Pushkov *In its* Geophys. Bull., No. 13 1966 p 1–15 (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

The International Quiet Sun Year (IQSY), an international project in the field of helio- and geophysics, is discussed. Its purpose is to ensure joint investigation by scientists of various countries of relationships between solar and terrestrial phenomena, and to elucidate the peculiar features of geophysical processes in the period of minimum solar activity. During the two-year period attenuation of solar radiation will be studied by direct measurements on satellites and rockets. Other activities of IQSY satellites will be to furnish information on cloud cover, provide worldwide magnetic mapping, and perform meteorological observations to investigate the physics, dynamics, and thermodynamics of the upper atmospheric layers, and also the relationship of the upper and lower atmospheric layers in the epoch of minimum solar activity. S.P.

N67-14223*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE INTERNATIONAL OCEANOLOGIC EXPEDITION IN THE INDIAN OCEAN

N. N. Sysoev *In its* Geophys. Bull., No. 13 1966 p 16–31 refs (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Various activities of countries involved in the International Indian Ocean Expedition are briefly discussed. A map illustrating sea routes of Soviet expedition vessels is presented. Their investigations included measuring currents, echo soundings, and geophysical measurements. The U.S. program is described as the most extensive with provisions for geological and hydrophysical research, echo sounding, biological studies, meteorological observations, and ocean level study. Great Britain's efforts to construct a relief chart of the Indian Ocean bottom, and Japan's program for a quasisynoptic charting of the eastern part of the Ocean are mentioned. S.P.

N67-14224*# Israel Program for Scientific Translations, Ltd., Jerusalem.

RESEARCH ON THE WORLD OCEAN

V. N. Stephanov *In its* Geophys. Bull., No. 13 1966 p 32–36 refs (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

The plan for systematic research of the World Ocean, which envisages comprehensive oceanographic surveys and construction of stations at specific points, is described. Oceanological research of natural resources of the oceans, radioactivity, the influence of the hydrosphere on climate and possibility of controlling it are aims of the international program. Specific activities mentioned include U.S. echo sounding; gravimetric, geomagnetic, and meteorological observations; determining physical and chemical surface parameters; and doing biological research. It is suggested that the variability of hydrometeorological processes be the basis of study, that a telemetric system be used to transmit results of measurements at fixed intervals, and that synchronized observations be constantly repeated over the entire world ocean. S.P.

N67-14225*# Israel Program for Scientific Translations, Ltd., Jerusalem.

REASONS FOR YEARLY VARIATION OF THE ATMOSPHERIC ELECTRIC FIELD POTENTIAL GRADIENT

T. V. Lobodin *In its* Geophys. Bull., No. 13 1966 p 37–41 refs (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Consideration is given to the yearly variation of the atmospheric electric field potential grandient E and the variation of thunderstorm activity. A definite direct correlation is sought not only between the daily unitary variations of the potential gradient and the thunderstorm activity, but also between the yearly variations of these quantities. It is demonstrated that local variations of electric conductivity cannot account for the yearly variation of E. Then it is assumed that the yearly variation of E is determined by the atmospheric volume charges. The basic argument generally quoted in favor of the thunderstorm theory is the result of current measurement above thunderstorms; however, the fact that not all thunderstorm clouds are positive from above and negative from below has been formerly neglected. If the varying polarization of thunderstorm clouds is considered, it can be concluded that commonly accepted charging currents attributable to thunderstorms have substantially exaggerated. It seems, however, that the thunderstorm mechanism alone cannot account for the electric field in fair weather. S.P.

N67-14226*# Israel Program for Scientific Translations, Ltd., Jerusalem.

RELATIONSHIP OF THE INTENSITY OF THE ELECTRIC FIELD OF THE ATMOSPHERE WITH POLAR AURORAE

T. V. Lobodin *In its* Geophys. Bull., No. 13 1966 p 42–44 refs (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Factors responsible for the relationship of polar aurorae with the atmospheric electric field were studied by comparing arctic and antarctic regional intensity values. Data on unitar daily and yearly variations as well as electric field behavior during polar aurora were obtained with an electrostatic fluxmeter and continuously recorded on an electronic potentiometer. It was found that polar aurorae behave as a positive volume charge in the Southern Hemisphere and as a negative charge in the Northern Hemisphere. G.G.

N67-14227*# Israel Program for Scientific Translations, Ltd., Jerusalem.
INITIAL GRAVIMETRIC BASES IN THE ANTARCTICA
Yu. N. Avsyuk and Yu. D. Bulanzhe *In its* Geophys. Bull., No. 13 1966 p 45–46 (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Various data on the force of gravity, accumulated by numerous Antarctic bases, were reduced to a common system that used the Mirny Antarctic settlement as point of reference. The gravity for this base in the Potsdam system was established as g=982,407.4±2.0 mgl. Results of gravity force measurements from five intracontinental Soviet Antarctic stations were reduced to the above g-value for Mirny and are shown in table form. G.G.

N67-14228*# Israel Program for Scientific Translations, Ltd., Jerusalem.
DENSITY, TEMPERATURE, AND PRESSURE OF THE ATMOSPHERE FROM PHOTOGRAPHIC OBSERVATIONS OF METEORS
P. B. Babadzhanov, L. A. Katasev, V. P. Konopleva, and E. N. Kramer *In its* Geophys. Bull., No. 13 1966 p 47–53 refs (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Photographic meteor observations during the IGY were evaluated for atmospheric density, temperature, and pressure. All data for altitudes >70 were in good agreement with values obtained by NASA. G.G.

N67-14229*# Israel Program for Scientific Translations, Ltd., Jerusalem.
TRIGONOMETRIC LEVELING ON THE KOMSOMOL'SKAYA-SOVETSKAYA-VOSTOK-KOMSOMOL'SKAYA PROFILE
G. E. Lazarev *In its* Geophys. Bull., No. 13 1966 p 54–62 ref (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Trigonometric leveling methods were used to determine the height of the ice cap and particularly of station altitudes located in the interior of Antarctica for a profile of 870 km. Physical and graphical factors were obtained and the height of 259 geodesic points was determined from theodolite, astronomical compass, and angle gage measurements. Results showed that between 0 and 20 hours the influence of refraction was minimal for trigonometric leveling work in the Antarctic. Mathematical analysis of the observations by serial surveying found an error of +5.6 m in closing the gigantic triangular polygon; height error at the initial point was ±2.7 m, and the rms error in the middle of the line was ±2.9. G.G.

N67-14230*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THICKNESS OF THE ICE COVER OF THE CENTRAL REGIONS OF EASTERN ANTARCTICA
A. P. Kapitsa *In its* Geophys. Bull., No. 13 1966 p 63–71 refs (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

An analysis of seismic sounding and gravitational data which were compiled by the Fourth Soviet Antarctic Expedition and used to construct the ice cover profile between Komsomol'skaya and the South Geographic Pole is presented. Summarized are data on the route traveled and traverse time, equipment modifications used in conjunction with a portable seismo station to register high frequency oscillations in the range 180 to 200 cps, and problems arising from background noise and equipment inaccuracies. Analysis of the seismograms obtained showed the mean velocity of propagation of seismic waves within the ice cover to be 3780 m/sec. The error in determination of the thickness of the ice cover did not exceed 5%. Using existing data for the profile Mirny (Pole of relative inaccessibility) the mean altitude and ice cover thickness along the profile Komsomol'skaya (South Pole) were computed and tabulated. The mean thicknesses on both profiles are shown to differ by more than 30%, while the altitudes differ by no more than 10%. Also presented are data on the isostatic sagging of the crust under the weight of the Antarctic ice cover. S.C.W.

N67-14232*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE FIRST INTERNATIONAL SYMPOSIUM ON RECENT CRUSTAL MOVEMENTS
Yu. A. Meshcheryakov *In its* Geophys. Bull., No. 13 1966 p 74–77 (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Presented is a synopsis of the proceedings of the First International Symposium on Recent Crustal Movements which was held from May 21 to May 26, 1962 in Leipzig, Germany. About 100 scientists from Austria, England, Bulgaria, Hungary, East Germany, Denmark, Italy, Poland, Southern Rhodesia, Roumania, the USSR, Finland, France, West Germany, Czechoslovakia, Switzerland, Sweden, Norway, and Japan participated in the symposium. Among the papers presented are cited studies of: geodesic problems of recent crustal movements; methods of determining vertical crustal movement; recent crustal movements in Austria; level measurements (oceanographic observations) as a method for studying recent crustal movement; the connection between recent crustal movements and earthquakes; geological and geomorphological problems arising in the study of recent crustal movements; recent movements in the Caucasus; horizontal displacements of continents and the connection between recent crustal movements and abyssal processes; and the application of tiltmetric and gravimetric methods to studies of recent crustal movement. Also cited is a paper on geodesic research being performed in the region of the reservoir being filled on the Zambesi River which will be used to estimate the effect of water masses on the character of deformations of the earth's crust. S.C.W.

N67-14233*# Israel Program for Scientific Translations, Ltd., Jerusalem.
RESOLUTIONS OF THE FIRST INTERNATIONAL SYMPOSIUM ON RECENT CRUSTAL MOVEMENTS
In its Geophys. Bull., No. 13 1966 p 78–80 (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Outlined are resolutions of the First International Symposium on Recent Crustal Movements among which are cited: (1) Close cooperation of the International Geodesic and Geophysical Union with the International Astronomical Union (IAU) in the study of the great horizontal displacements of continents; (2) The creation within the framework of the IAU special research groups for the study of the contemporary movement of the earth's crust in various territories; (3) International cooperation in organizing observations of variations in crustal movements and the creation of special proving grounds for the study of local vertical and horizontal crustal movements; and (4) The initiation of studies focusing on finding wider application of existing methods used to study tides in the solid earth and in seismologic research which reveal completely new possibilities for studies of recent crustal movements. Recommendations for the exchange of research data and the publication of materials of the Symposium are also cited. S.C.W.

N67-14236*# Israel Program for Scientific Translations, Ltd., Jerusalem.
CONFERENCE ON STUDY OF THE EARTH'S MAGNETIC FIELD IN THE WORLD OCEAN
D. L. Finger *In its* Geophys. Bull., No. 13 1966 p 101–103 (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

The minutes of a conference on the study of the earth's magnetic field in the oceans are reported, including summary

remarks on the papers presented and the discussion held. Emphasis was placed on the necessity for more accurate maps of the earth for sea and air navigation, for the compilation of general maps of normal fields, the isolation of magnetic anomalies, the study of ocean currents by the electromagnetic method, and the analysis and interpretation of magnetic observations made by rockets and satellites in space. L.E.W.

N67-14237*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE SECOND ALL-UNION GLACIOLOGICAL SYMPOSIUM
V. M. Kotlyakov *In its* Geophys. Bull., No. 13 1966 p 104–108 refs (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

The proceedings of a conference of glaciologists, devoted to presentation of the overall glaciological results of the International Geophysical Year, are summarized. Various problems of glaciology are outlined, and several solutions are proposed. A system of equations of state for an unstable glacier is described, which was derived from the equation of continuity of an unstable glacier, the equation of dynamic equilibrium, and the rheological equation of state. Summaries are given of the papers presented on such topics as the reason for the recent tendency to the development of glaciation on the globe, glacier variation, dynamics of glaciers and epochs of macrocirculation, and bottom melting in the central zone of the Antarctic ice shield and its influence on the present material balance of the ice. L.E.W.

N67-14259*# Consultants and Designers, Inc., Arlington, Va.
EFFECT OF NEGATIVE IONS ON THE DIFFUSION OF CHARGED PARTICLES IN THE LOWER IONOSPHERE [VLIYANIYE OTRITSATEL'NYKH IONOV NA DIFFUZIYU ZARYAZHENNYKH CHASTITS V NIZHNEY IONOSFERE]
E. I. Ginzburg 13 Sep. 1965 6 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 8, no. 3, 626–627
(Contract NAS5-3760)
(NASA-CR-80852; ST-AI-PF-10385) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The solution is presented that is based upon the fact that the diffusion process in a plasma in the presence of a magnetic field takes place at the velocity rate of slower particles (electrons and positive ions). The electric field, emerging on account of the difference in the diffusion rates of electrons and ions, hampers a further separation of these particles. This is evidence that the presence of negative ions may substantially modify the character of the diffusion process. Author

N67-14261# Royal Aircraft Establishment, Farnborough (England).
THE ROTATIONAL SPEED OF THE UPPER ATMOSPHERE: A REVIEW
D. G. King-Hele and R. R. Allan Jul. 1966 40 p refs
(RAE-TR-66212) CFSTI: HC $2.00/MF $0.50

The document describes the method for determining the rotational speed of the earth's upper atmosphere from the changes in the orbital inclinations of satellites, and briefly reviews the observational results so far obtained at heights above 180 km, both by this method and by measuring the movements of vapor trails. The results from satellite orbits indicate that the upper atmosphere at heights of 200–300 km is on average rotating 1.3 times faster than the earth, corresponding to a mean west-to-east wind of about 100 m/s in mid latitudes. The physical processes which may control upper-atmosphere movements are outlined, and possible mechanisms for the observed motions are briefly discussed. Author (ESRO)

N67-14310# Royal Aircraft Establishment, Farnborough (England).
SOME CALCULATIONS OF IONOSPHERIC REFLECTION COEFFICIENTS FOR LOW FREQUENCY RADIO WAVES
B. Burgess and Greta C. A. Sunderland Min. of Aviation, Jul. 1966 28 p refs
(RAE-TR-66221) CFSTI: HC $2.00/MF $0.50

Presented are results of computations of the reflective properties of a sharply bounded ionosphere for low frequency radio waves. The method of Barber and Crombie has been adopted. It is shown that for this ionospheric model the phase of the reflection coefficient varies with frequency in a manner which is of importance when radio navigational aids in this frequency band are considered. Author (ESRO)

N67-14319# Joint Publications Research Service, Washington, D. C.
PROPAGATION OF ELECTROMAGNETIC WAVES THROUGH A NUCLEAR DETONATION-PRODUCED RADIATION FIELD
Shen Ching 7 Dec. 1966 22 p refs Transl. into ENGLISH from Yuan-Tzu-Neng (Peiping), no. 4, Apr. 1966 p 239–253
(GUO-2250) CFSTI: $1.00

This paper discusses theoretically the nature of the source and function of free electrons in the radiation field of a nuclear detonation and microstructural and macrographic phenomena of atmospheric activities at low altitudes. Electromagnetic parameters have been calculated and qualitative results of the propagation of electromagnetic waves in the radiation field of nuclear detonation have been obtained. Under ideal conditions, some quantitative results can be obtained using the proposed formulae. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N67-13401# Technology, Inc., San Antonio, Tex. Life Sciences Div.
RESEARCH ON OCULAR EFFECTS PRODUCED BY THERMAL RADIATION Final Report, 15 Jun. 1965–15 Jun. 1966
Thomas A. Alexander, Ralph G. Allen, Jr., Roger L. Bessey, William R. Bruce, Earl R. Lawler, Jr. et al Brooks AFB, Tex., AF School of Aerospace Med., Jul. 1966 150 p refs
(Contract AF 41(609)-2906)
(AD-638642) CFSTI: HC $4.00/MF $1.00

CONTENTS:

1. CALIBRATION OF ZEISS PHOTO COAGULATOR R. L. Bessey and R. G. Allen, Jr. 32 p refs (See N67-13402 04-14)

2. OPERATING INSTRUCTIONS FOR MODIFIED ZEISS PHOTO COAGULATOR E. R. Lawler, Jr. and W. R. Bruce 26 p refs (See N67-13403 04-14)

3. A STUDY OF THE PRODUCTION OF CHORIORETINAL LESIONS BY THERMAL RADIATION T. A. Alexander, R. G. Allen, Jr., R. L. Bessey, E. R. Lawler, Jr., and W. R. Bruce 25 p refs (See N67-13404 04-04)

4. AN EXAMINATION OF THE PRODUCTION OF CHORIORETINAL BURNS IN TERMS OF TEMPERATURE DISTRIBUTIONS R. G. Allen, Jr., A. F. Muller, E. R. Lawler, Jr., and W. R. Bruce 39 p refs (See N67-13405 04-04)

5. MEASUREMENTS OF THE TOTAL LUMINOUS ENERGY OUTPUT OF TWO HONEYWELL STROBONAR FLASH UNITS C. A. Polaski and R. G. Allen, Jr. 15 p (See N67-13406 04-14)

N67-13402# Technology, Inc., San Antonio, Tex. Life Sciences Div.

CALIBRATION OF ZEISS PHOTO COAGULATOR

Roger L. Bessey and Ralph G. Allen, Jr. *In its* Res. on Ocular Effects Produced by Thermal Radiation Jul. 1966 32 p refs (See N67-13401 04-14) CFSTI: HC $4.00/MF $1.00

A modified Meyer-Schwickerath photo coagulator was developed to study the production of thermal lesions in rabbits and primates. In order to obtain quantitative data on the thermal exposures administered to animals being investigated, it was necessary to measure the spectral irradiance as well as the total irradiance for the conditions under which the source was to be operated. The method of calibration, calibration results, and acomparison between directly measured total irradiance and spectral irradiance integrated over wavelength are presented. Author

N67-13403# Technology, Inc., San Antonio, Tex. Life Sciences Div.

OPERATING INSTRUCTIONS FOR MODIFIED ZEISS PHOTO COAGULATOR

Earl R. Lawler, Jr. and William R. Bruce *In its* Res. on Ocular Effects Produced by Thermal Radiation Jul. 1966 26 p refs (See N67-13401 04-14) CFSTI: HC $4.00/MF $1.00

Complete operating and maintenance instructions are presented for the modified Zeiss coagulator and associated pulse control unit. The Zeiss light coagulator and associated components are used to produce a high intensity pulsed light for retinal burn studies. The basic theory of operation is presented as well as some irradiance calculations. The exposure procedure is outlined, and maintenance of equipment is described. S.P.

N68-13408# Technology, Inc., San Antonio, Tex. Life Sciences Div.

MEASUREMENTS OF THE TOTAL LUMINOUS ENERGY OUTPUT OF TWO HONEYWELL STROBONAR FLASH UNITS

Charles A. Polaski and Ralph G. Allen, Jr. *In its* Res. on Ocular Effects Produced by Thermal Radiation Jul. 1966 15 p (See N67-13401 04-14) CFSTI: HC $4.00/MF $1.00

The luminous and radiant emittance of flash units (Model 65C and Model 800) were measured indirectly by measuring the illuminance and irradiance at a point 100 cm from these light sources. The spectral distribution of the Model 800 was also measured in the range of 400 to 700 millimicrons. The total luminous emittance of the Model 800 was found to be 7.4 lumen-sec/cm^2 on battery operation and 72.7 lumen-sec/cm^2 on ac operation. The total luminous emittance of the Model 65C was found to be 63.3 lumen-sec/cm^2 on ac operation. The total radiant emittance of the Model 800 was found to be 0.463 cal/cm^2 on battery operation 0.453 cal/cm^2 on ac operation. The total radiant emittance of the Model 65C was found to be 0.394 cal/cm^2 on ac operation. Author

N67-13459# Aerodynamische Versuchsanstalt, Gottingen (West Germany). Abteilung Gasdynamik.

TEMPERATURE MEASUREMENTS IN A SMALL TUBE WIND TUNNEL [TEMPERATURMESSUNGEN IN EINEM MODELL-ROHRWIND-KANAL]

K. Lipowski Aug. 1966 34 p refs In GERMAN; ENGLISH summary

(DLR-FB-66-56; AVA-FB-66-10) CFSTI: HC $2.00/MF $0.50

Temperature measurements were performed in the small wind tunnel at Mach numbers of 3.00; 3.66 and 4.85 in order to prepare heat transfer measurements on bodies in hypersonic flow. This report shows the development of a thermoprobe for short-time measurements by means of which the temperature–time history was found at different positions in the test section and pressure reservoir of the tube wind tunnel. For three Mach numbers the characteristic records are compared and interpreted with view to heat transfer measurements in preparation. Author

N67-13461# Michigan Univ., Ann Arbor. Inst. of Science and Technology.

PROCEEDINGS OF THE FOURTH SYMPOSIUM ON REMOTE SENSING OF ENVIRONMENT

Jun. 1966 940 p refs Symp. held in Ann Arbor, Mich., 12–14 Apr. 1966 Sponsored by ONR and AFCRL

(Contract Nonr-1224(44))

(Rept.-4864-11-X; AD-638919) CFSTI: HC $8.75/MF $3.50

Symposium papers on needs and applications for remotely sensed data, interdisciplinary educational needs, equipment design, and data acquisition, analysis, and management are presented. For individual titles see N67-13462–N67-13529.

N67-13471# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

FORESTRY APPLICATIONS OF REMOTE SENSING

R. C. Wilson *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 63–70 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Currently serial cameras are used almost exclusively for a number of important forestry applications of remote sensing, such as resource management inventories, land classification, and damage detection. An expansion of remote sensing to aid foresters in exploring, developing, and managing timberlands and associated wildlands is anticipated. Current research suggests increasing emphasis on the use of photography from space and other imagery such as that from thermal infrared sensors. A specific range in resolution of ground features is recommended for each forestry application. This in turn suggests the characteristics required in the sensor. Author

N67-13472# California Univ., Berkeley. School of Forestry.

USES AND LIMITATIONS OF MULTISPECTRAL REMOTE SENSING

Robert N. Colwell *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 71–100 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Some enthusiastic proponents of multispectral remote sensing herald it as the means by which virtually all of man's data-gathering problems, both terrestrial and extraterrestrial, can best be solved. However, certain high-level decision-makers feel that such optimism is not justified. They assert that little or no information of vital importance has been found to be better derivable through multispectral remote sensing than through any of several other less sophisticated means. Consequently they are of the opinion that the continuation of a vigorous research and development program in this area is unwarranted. Perhaps both groups need to examine more carefully, and in more specific terms, the uses and limitations of multispectral remote sensing. This paper undertakes such an examination through the use of both specific examples and analytical discussions of the

various factors governing remote sensing. It is hoped that the approach used here will help to place in better focus both the enthusiastic claims and the pessimistic criticisms, thereby assisting the reader in formulating his own opinion relative to the potential usefulness of multispectral remote sensing. Author

N67-13473# Institute for Defense Analyses, Arlington, Va.
PROBLEMS IN NEAR REAL TIME RECONNAISSANCE
Lucien M. Biberman *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 101–110 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

In the case of night air reconnaissance the requirements for wide field coverage and for a means of detailed search of a more localized area for target acquisition are considered. Night vision equipments must have a fixed number of resolution elements depending principally on brightness of the scene, contrast of the target, collecting power of the optics, and size of the image tube. A visual search is necessary when the following determinants are present: interposition, smallness, weakness, distortion, imbeddedness, and competition. Three different sets of parameters are involved in the design of imaging systems for airborne applications. The first set of parameters that govern the quality of the imagery deals with the characteristics of the scene—its radiance, reflectivity, contrast of target objects to background, size of target objects to be resolved, and slant range from aircraft to scene. The second set deals with the sensor—angular coverage, sensitivity, angular resolution, and contrast transfer characteristics. The last set deals with the vehicle—ground speed, pitch and yaw rates, as well as vibration. S.P.

N67-13476# Northwestern Univ., Evanston, Ill.
SOME OBSERVATIONS ON THE UTILITY OF MULTISPECTRAL PHOTOGRAPHY FOR URBAN RESEARCH
Duane F. Marble and Edwin N. Thomas *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 135–144 refs Sponsored by NASA and ONR (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

At the present time it is appropriate to evaluate the utility of multispectral photography for urban research as part of the critical reappraisal of research and planning activities which is currently being undertaken by a number of public and private agencies. Some preliminary research is discussed on the use of multispectral photography in urban research which was undertaken as part of a broader program dealing with the use of a variety of remote sensors to collect urban data. Existing evidence indicates that multispectral imagery will provide information about static physical and man-made elements of the urban environment. It appears, however, that much additional experimentation is needed before multispectral photography and other remote sensors can be efficiently incorporated into operational urban information systems. Author

N67-13486# Naval Oceanographic Office, Washington, D.C.
ENVIRONMENTAL CORRECTIONS FOR AN AIRBORNE RADIATION THERMOMETER
Robert L. Pickett *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 259–282 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The thermometer measures sea surface temperatures from an aircraft by recording the intensity of infrared radiation in the 8 to 13-micron band from the ocean surface. Primary purpose of the measurements is supplementation of surface temperature data obtained by ships. Readings sometimes disagree with conventional bucket temperatures beyond limits of instrument calibration accuracy. This is attributed to variable atmospheric conditions, such as humidity, air temperature, clouds, and rain, and to variable sea conditions, such as temperature structure and waves. This paper lists the magnitude of disagreement and describes an empirical method for reducing the disagreement by environmental correction of the values. This correction technique can also be used on other remote sensors, and it is useful when theory or experimentation are lacking. K.W.

N67-13493# New Brunswick Univ., Fredericton.
GEOMETRICAL CONSIDERATIONS FOR MAPPING FROM SCAN IMAGERY
Gottfried Konecny and Eugene E. Deremyi *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 327–338 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Scan photography and the geometrically related scan imagery introduce a variety of geometrical problems which make their use for mapping a difficult task. Ways of achieving a complete geometrical evaluation are outlined. Formulations for frame photography, strip photography, panoramic scan photography and line scan imagery are compared. An example for the theoretical fidelity of line scan imagery is presented; other passive and active imagery systems are discussed. Author

N67-13494# Kansas Univ., Lawrence. Center for Research in Engineering Science.
RADAR SCATTEROMETRY–AN ACTIVE REMOTE SENSING TOOL
R. K. Moore *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 339–373 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50
(Contract NSR-17-004-003)

The radar scatterometer measures variation of the radar scattering coefficient with angle, wavelength, and polarization. These variations may be used by geoscientists to discriminate between surfaces with different roughness and materials. For example, such a system has been proposed to determine from a satellite the height of ocean waves, and from this to infer the wind field over the world's oceans. Radar scatterometers may be built using different combinations of angle, range, and speed measurement to discriminate among surface elements. Various systems are described, but only the range-angle system is studied in detail. The sizes of the areas sampled and the size of sample required for adequate statistics are described. Various data presentation methods are suggested. Author

N67-13495# Emerson Electric Co., Santa Barbara, Calif. STAR Div.
FOURIER ANALYSIS OF AERIAL PHOTOGRAPHS
Richard H. Brody and J. R. Ermlich *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 375–392 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Aerial photographs are analyzed for spatial frequency content by use of an Optical Fourier Analyzer. The scenes include natural and cultural features, and thus represent a reasonable sampling of typical imagery. Spectra were derived in several directions across each scene, to form a limited reproduction of the corresponding true two-dimensional spatial Fourier transforms. The measured transforms (spatial frequency spectra) of simple images conform closely with the results predicted from analysis of simplified models of the scenes. Significant differences have been found between the spectra obtained from natural and man-made features, and a powerful means of highlighting these differences has been explored. This method involves examination of the signal generated when the two-dimensional Fourier transform is rotationally scanned at a constant rate for a range of spatial frequencies. Author

N67-13500# Naval Oceanographic Office, Washington, D. C.
EXTRACTION OF NAUTICAL CHART INFORMATION FROM COLOR PHOTOGRAPHS OBTAINED ON GEMINI ORBITAL FLIGHTS 4, 5, AND 7
Richard F. Gettys *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 457–465 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

To determine whether hyperaltitude photography offers a possible means for upgrading and updating nautical chart data, a preliminary study has been made of photography obtained over ocean areas with a hand-held 70mm camera aboard GEMINI orbital flights numbers 4, 5, and 7 at altitudes of approximately 90 to 180 nautical miles during 1965. Results of this study indicate that GEMINI color photography may be used to identify areas on small scale charts needing revision, but the information that can be extracted is limited. Author

N67-13501# Space-General Corp., El Monte, Calif.
CHARACTERISTICS AND USES OF AN L-BAND RADIOMETER
William H. Conway and Lavern A. Yarbrough (Tex. Instr., Inc.) *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 467–473 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

A tuneable airborne L-band radiometer was designed to provide reliable operation over a long period of time with a minimum of operator adjustment. To meet these design constraints, a unique system of automatic gain control (AGC) was applied, using a gas discharge noise tube as a reference source. In effect, this AGC system constantly adjusted the gain of the unit to maintain initial calibration. An additional advantage was obtained from the gas discharge noise source by using an automatic noise figure meter as the noise tube driver; the system operation could then be continuously monitored by front panel metering. This noise figure meter also provided the most important piece of maintenance equipment needed for the radiometer. The output of the radiometer was fed to an oscillograph to provide an instantaneous and permanent record of data collected from a variety of targets. Selected frequencies of operation were chosen to provide optimized operation while flying over specific areas of interest. Various materials and manmade signals produced characteristic target signature data which reveal the potential of an L-band radiometer operating at 700 MC as a reconnaissance instrument. Author

N67-13504# Florida Atlantic Univ., Boca Raton.
RESUME OF THE SPECIAL SESSION ON REMOTE SENSING HELD AT THE 1965 AAAS MEETING
James P. Latham *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 539–546 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Invited panelists presented recent findings and a survey of the art in a symposium on the remote sensing of environment at a science association meeting. Journalists attending the meeting provided unusual nationwide press reporting of the remote sensing capabilities. Author

N67-13506# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
A METHOD OF SHOWING WHAT A RADIOMETER "SEES" DURING AN AIRCRAFT SURVEY
Robert L. Grossman and William E. Marlatt *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 571–574 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The aircraft-borne infrared technique of conducting a surface temperature survey is discussed, and a method for assessing surface conditions during the flight is proposed. The scheme for achieving such a record is to mount a camera close enough to the radiometer to provide minimum parallax and to film the surface during the run. The film is then synchronized to a film made of the recorder strip chart and optically mated to provide one film in which the strip chart measurement is shown over the surface corresponding to the measurement at that time. Being a cine-film process the record is to a high degree continuous in time and space, and frames may be examined for detail if desired. The result of the technique is one film with the recorded data as a white line passing an ordinate scaled with quantitative values of the measurement (also white) superimposed upon the color depiction of the ground. S.P.

N67-13508# East Tennessee State Univ., Johnson City.
REMOTE SENSOR RETURNS AS HISTORICAL DOCUMENTS
David Edward Harrell, Nicholas C. Crawford, and Robert W. Peplies *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 599–604 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

This paper will explore the potential of remote sensor returns as source materials for social scientists. In order to explore the possible uses of remote sensor images and signatures as historical documents, air photo images of past landscapes of the Asheville basin, North Carolina, were examined. The study indicated that remote sensor data has important implications for the historical profession. First, historians will be provided with another tool which will substantially broaden their research potential. Second, the technical nature of much of the information will demand an interdisciplinary approach on the part of the historian, and probably a certain amount of training in the pertinent scientific areas involved. Author

N67-13513# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
POLARIMETRY SIGNATURE OF TERRESTRIAL AND PLANETARY MATERIALS
Walter G. Egan and Herbert B. Hallock *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 671–689 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Terrestrial materials reveal polarization characteristics in reflected and emitted light which are functions of the phase (incident plus emergent) and the viewing (emergent) angles of the surface, as well as the spectral range. The polarization characteristics are exhibited by all surfaces, and are functions of the geometry and physical properties. Such geometrical properties as surface smoothness, albedo, multiple scattering, particle size, shape, or spacing, and macrostructure can influence the polarization characteristics as well as physical properties such as dielectric constant, permeability and conductivity. Data will be presented to indicate the diversity of polarimetric signatures that are obtained on some materials. The data has been obtained, in part, on a large scale spectral polarimeter which permits observations to be made in the visible and infrared. Author

N67-13517# Ohio State Univ., Columbus. Dept. of Geology.
EDUCATIONAL NEEDS IN THE FIELD OF REMOTE SENSING
Charles H. Schultz *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 713–715 *ref* (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Problems and solutions with regard to educational needs in remote sensing are proposed. It is stated that the major need is to acquaint environmental scientists such as geologists, geographers, and oceanographers with remote sensing techniques

and the potential uses of various sensors. To solve this problem, it is suggested that selected research findings be published in standard journals of the environmental sciences. Other proposals are seminars in geology, forestry, and geography; a textbook dealing with the whole field of remote sensing; and reduction of the military aspect of the overall sensor program. S.P.

N67-13518# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

A CONSIDERATION OF METHODOLOGY IN PHOTO INTERPRETATION

Philip L. Johnson *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 719–725 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Instruction in remote sensing and photo interpretation for biological purposes is just developing beyond the forestry curriculum. The need is immediate and crucial to develop this new technology for application to broad ecological problems involving food supply, waste disposal and pollution, resource inventory and management, and environmental manipulation. Methods of teaching interpretation and deriving inferences are discussed in terms of mechanical techniques, reasoning processes, and technical examples. An entropy model for information extraction is offered. It is concluded that a theoretical foundation is needed as well as specific solutions to biological problems if remote sensing technology is to enter the arsenal of the ecologist. Author

N67-13520# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

TERRAIN INTERPRETATION FROM RADAR IMAGERY

John M. Mc Anerney *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 731–750 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The interpretation of physiographic and cultural terrain features from imagery obtained with high resolution, side-looking radar alone is demonstrated. Two areas in the central United States are used as examples. Through a deductive process similar to that used in interpretation of visual aerial photography, it is shown that a trained interpreter can describe the physiography, geology and soil of a land surface and provide a reasonable assessment of the geography of a populated region. The discussion includes an example of measuring terrain relief from radar shadows. Author

N67-13522# Ohio State Univ., Columbus. Antenna Lab.

THE MUTUAL INTERPRETATION OF ACTIVE AND PASSIVE MICROWAVE SENSOR OUTPUTS

William H. Peake, R. L. Riegler, and Charles H. Schultz *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 771–777 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

(Grant NSR-36-008-027)

The interpretation of surface characteristics from microwave sensor outputs alone is more effective when data is available from both active (radar) and passive (radiometer) sensors. This is because both outputs are determined by the complete scattering pattern of the surface; of which one aspect (backscatter) is estimated by the radar and another (albedo) is estimated by the radiometer. However, because the radiometer output is the convolution of the desired radiation temperature of the surface and the antenna pattern, it is first suggested that this instrumental bias be removed. An example is given, used to show that the correction is a significant one for current radiometer performance, and should be applied by those investigators wishing to make quantitative interpretations of apparent surface temperatures. As examples of the interdependence of active and passive sensor outputs, and their relation to significant surface properties, results are given for two series of measurements, made almost simultaneouly with radar and radiometer sensors (at 10 GHz and 35 GHz) over well controlled terrain. Author

N67-13529# Space-General Corp., El Monte, Calif.

3.2-MM THERMAL IMAGING EXPERIMENTS

Gregory T. Chalfin and W. B. Ricketts *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 859–871 *ref* Sponsored by Bur. of Naval Weapons (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Millimeter-wave thermal-imaging experiments were obtained at a wavelength of 3.2 mm (94 GHz). The sensor was a super-heterodyne radiometer having a ΔT of 10°K for the integration time used. A resolution cell of approximately 0.5° was used and images were obtained having about 50 scan lines with about 90 resolution cells per scan line. The radiometer output was recorded on magnetic tape. The tapes were processed by a computer to correct certain distortions and to obtain contrast enhancement. The images were displayed by a incremental plotter programmed to produce half-tone images. Analysis of the images shows that the contrast between reflectors such as water or metal and absorbers such as vegetation is always very prominent at 3.2 mm. Also, the contrast between rough and smooth soil surfaces is usually detectable. Reflections from smooth surfaces such as water and snow are prominent and, in the case of water, the cleanness of the reflection depends on the smoothness of the surface in a manner very similar to reflections in the optical range. In general, the gross features of the 3.2 mm images correspond very closely to visible-light photographs of the same area. However, in heavy fog, where visible and near-infrared photographs show practically nothing, a useable image can still be obtained at 3.2 mm. Author

N67-13536*# General Electric Co., Cincinnati, Ohio. Materials Development Lab.

DEVELOPMENT OF HIGH-TEMPERATURE CHROMIUM ALLOYS Semiannual Report

J. W. Clark and C. S. Wukusick 22 Apr. 1966 57 p refs

(Contract NAS3-7260)

(NASA-CR-80657; SAR-2) CFSTI: HC $3.00/MF $0.50 CSCL 11F

Some 40 chromium alloys have been induction melted, cast as ingots of about four pounds each, and processed to small-dimeter bar stock. In addition, over 150 compositions were arc melted as 50 to 100 grams buttons and were selectively evaluated with respect to critical properties. Several of the dilute dispersion-strengthened alloys exhibited ductility at sub-zero temperatures combined with tensile strengths over 35,000 psi at 1900°F. Addition of 4 atomic percent Mo raises the tensile strength of carbide-containing alloys to about 60,000 psi at 1900°F, with the expected expense to low-temperature ductility. Additions of W are even more effective strengtheners, with tensile strengths of 81,000 and 30,000 psi at 1900° and 2400°F respectively being measured in a Cr-6W-1Y alloy, but have a more detrimental effect on the workability than does Mo. The most promising approach identified in the button alloys is the use of La to inhibit nitridation and consequent embrittlement during air exposure at elevated temperatures. Even compositions containing carbides rich in Cb or Ta, which otherwise are highly susceptible to nitrogen attack, resist such attack in alloys with additions of 0.3 to 0.5 atomic percent La. Lower concentrations are equally effective in alloys with Group IV A carbides, which have better inherent resistance to nitridation. Author

N67-13591# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

APPLICATION OF AN ELECTROMAGNETIC METHOD TO DYNAMIC STABILITY MEASUREMENTS

F. W. Roos and A. M. Kuethe *In* Dayton Univ. Sum. of ARL Symp. on Magnetic Wind Tunnel Model Suspension and Balance Systems Jul. 1966 p 283-312 refs (See N67-13581 04-11)
CFSTI: HC $7.50/MF $2.00

An electromagnetic method of obtaining forced-oscillation dynamic stability data is described. This method utilizes the principle of the moving coil galvanometer in that an alternating current is passed through a coil mounted within the sting-supported test model, forcing it to oscillate in an impressed magnetic field. The phase angle by which the displacement of the model lags the oscillating torque is a direct measure of the damping of the system; comparison of data from wind-on and wind-off runs thus can be made to yield the aerodynamic damping. The method has the distinct advantage over the usual free oscillation tests of readily permitting the study of a considerable range of oscillation frequencies with a single model. Data from tests of two sharp cones at a Mach number of 2.5 in the reduced frequency range of $0.025 \leq \omega L/U \leq 0.105$ is presented and compared with theory and data from other sources. Possible improvements in the method are suggested and application of the technique to hypersonic testing is discussed. Author

N67-13629# Argonne National Lab., Ill.
MEASUREMENT OF BEAM PROFILES WITH THERMOLUMINESCENT DOSIMETERS
Herbert Lucks, Stewart M. Marcowitz, and Robert V. Wheeler Apr. 1966 9 p refs
(Contract W-31-109-ENG-38)
(ANL-7196) CFSTI: $1.00

Thermoluminescent dosimeters have been used to determine the profile of the 12.5-Bev external beam of the Zero Gradient Synchrotron at Argonne National Laboratory. The total number of particles in the beam, the distribution of particles, and the shape of the beam were determined. The results are in excellent agreement with results obtained by other techniques used for determination of beam profiles. Using only one accelerator pulse, a beam of comparable size with intensity up to 10^{12} particles per pulse and as low as 10^{6} particles per pulse could be analyzed. Author (NSA)

N67-13639# Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
CALIBRATION OF A WESTPHAL BALANCE AND PLUMMET Topical Report
H. L. Christopherson 12 Aug. 1966 6 p
(MCW-1473) CFSTI: $1.00

Equations were derived for the relationships that must exist among the volume of the plummet; the masses of the plummet, weights, and reference; and the densities of air and the reference fluid to obtain direct readings of either density or specific gravity. Suggestions are made for obtaining the relationships. A procedure is given for calibrating the Westphal beam notches. Author (NSA)

N67-13668*# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
AN INVESTIGATIVE STUDY OF A SPECTRUM-MATCHING IMAGING Final Report
Donald S. Lowe, John Braithwaite, and Vernon L. Larrowe Oct. 1966 112 p refs
(Contract NAS8-21000)
(NASA-CR-80724; Rept.-8201-1-F) CFSTI: HC $4.00/MF $0.75 CSCL 14E

Discussed is the classification of remote objects and materials on the basis of the spectrum of the solar radiation they reflect and of the thermal radiation they emit. A system for optimizing and evaluating these techniques is described. It consists of an analyzer, a processor, and an airborne data-collection subsystem. The airborne subsystem includes an optical-mechanical ground scanner integrated with a multichannel spectrograph, a control console, and a multichannel tape recorder. This subsystem will collect multichannel spectral data from the strip of territory being overflown. (The video data in any one channel could be used to construct a monochromatic strip map.) These data are recorded on parallel channels, one for each spectral interval. The tapes are later fed to the analyzer, which performs a statistical analysis of selections of the data corresponding to particular classes of objects or materials. The reduced statistics can then be used as classification keys in the processor. By using keys corresponding to a target and appropriate backgrounds, the processor can then locate specific targets from new data obtained with the airborne subsystem. Author

N67-13713# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
FOCUSING OF THE TIME-OF-FLIGHT DIFFRACTOMETER FOR STRUCTURE ANALYSIS
A. Holas Aug. 1966 26 p refs
(Contract IAEA-255/RB)
(INR-742/II/PS) CFSTI: HC $2.00/MF $0.50

The setting up of a neutron time-of-flight diffractometer for crystal structure analysis, which allows the use of large source windows, large samples and large detectors without broadening of the diffraction peak is described. Author

N67-13717# National Bureau of Standards, Washington, D. C. Metallurgy Div.
APPLICATION OF COMPUTERS TO QUANTITATIVE ANALYSIS OF MICROSTRUCTURES
George A. Moore 1 Oct. 1966 81 p refs Presented at 3d Intern. Mater. Symp., Berkeley, Calif., 13 Jun. 1966 Submitted for Publication
(NBS-9428)

The problems and methods of quantitative microscopy are basically identical in all microscopic sciences. Results are limited by the finite resolution of real micrographs and real observations and by the statistical necessity of processing a very large number of observations, thus dictating automatic scanning and computer processing methods. The presence or absence of a specific phase can be represented by a two-dimensional binary array which can be rapidly processed to yield the required measurements. Logical modification by the computer is frequently necessary to substitute for some of the logical discriminations normally made by the human analyst and to facilitate the desired measurements. Using high precision scanning equipment, the inaccuracies of measurement remain comparable to the limits imposed by statistics. Presently attainable precision is, however, an order of magnitude better than can normally be obtained by manual methods. Author

N67-13728*# Milliken (D. B.) Co., Arcadia, Calif.
NASA PROTOTYPE FILM TRANSPORT SYSTEM Final Project Report
28 Oct. 1966 6 p
(Contract NAS8-11627)
(NASA-CR-80743) CFSTI: HC $1.00/MF $0.50 CSCL 14E

A project to design and fabricate a prototype multiple film take-up system by which film exposed to four remote cameras in a launch vehicle can be controlled in a single recovery capsule was completed. A brief history of the project's progress is given, including the laboratory model single film design, fabrication, and test; prototype system design and fabrication; and the G.F.E. camera modification. Concerning goal accomplishments, the system

design configuration was proven successful on a single film system. A four track system take-up was designed and packaged within acceptable capsule size limitations. Capsule film port seals and a film cutting system were fabricated, tested, and proven successful. The G.F.E. camera was modified, tested, and successfully proven. The system operation of the DBM-3 camera operating through the transport tube onto the single film take-up system, and the operation of the film cutter were also successfully demonstrated.
R.N.A.

N67-13775# Army Nuclear Defense Lab., Edgewood Arsenal, Md.
EVALUATION OF THE RESPONSE OF SILICON DIODE DOSIMETERS TO FAST NEUTRONS
Eloy P. Vega, David T. Kilminster, and John H. Mc Neilly Oct. 1966 43 p refs
(NDL-TM-31; AD-641559) CFSTI: HC $2.00/MF $0.50

Conductivity-modulated, silicon p-n junctions of two base widths (10- and 50-mil) were exposed to a burst of fast neutrons. High-level lifetime, reverse-recovery lifetime, and forward voltage at four constant current levels were correlated with fast neutron kerma as measured by threshold detectors. This correlation showed that the sensitivity of the diodes varied with respect to kerma. The curves of high-level lifetime versus kerma and reverse-recovery lifetime versus kerma have two changes in slope, at 100000 ergs/g and at 1000000 ergs/g. The 10-mil diodes exhibited excellent reproducibility for both lifetime measurements; however, only 55 percent of the forward-voltage measurements were within plus or minus 10 percent of the average. The lifetime measurements of the 50-mil diodes were very poor (only 31 percent of the data was within plus or minus 10 percent) while the forward-voltage measurements were better (84 percent of the data was within plus or minus 10 percent).
Author (TAB)

N67-13836# Technisch Physische Dienst TNO-TH, Delft (Netherlands).
MEASURING AND CALIBRATION APPARATUS FOR INFRARED IMAGE TRANSFORMER TUBES, COPY NO. 14 [MEET- EN KEURINGSAPPARAAT VOOR INFRAROOD BEELDTRANSFORMATIEBUIZEN, EXEMPLAAR NO. 14]
H. J. Raterink and A. A. Schoenmaker 8 Feb. 1966 59 p In DUTCH
(Rept.-66-0-2)

The apparatus is designed for optical and electrical operations in measuring and calibrating two types of Dutch-made infrared image converter tubes. Compactness and simplicity of operation were stressed in the design. The capabilities of the two image converter tubes are discussed. A detailed description is given of the measuring and calibration apparatus and its accessories, including display panels, measuring tubes, test negatives, circuitry, filters, and a dummy image tube. Also given are methods for performing various accuracy tests.
Transl. by K.W.

N67-13872# Central Lab. for Radiological Protection, Warsaw (Poland).
MEASUREMENT OF Rn-222 CONCENTRATION IN AIR BY MEANS OF ELECTROSTATIC PRECIPITATION OF ITS DAUGHTER PRODUCTS [POMIAR STEZENIA Rn-222 W POWIETRZU METODA ELEKTROSTATYCZNEGO OSADZANIA JEGO PRODUKTOW ROZPADU]
T. Wardaszko 1966 11 p refs In POLISH; ENGLISH summary
(CLOR-47/D) CFSTI: HC $1.00/MF $0.50

The principle and realisation of a method of Radon-222 measurements in air by means of electrostatic precipitation of its daughter products is described. A 3-liter steel chamber fitted with collecting electrode was used, the latter being simultaneously an alpha radiation detector of suitable geometry. The counting efficiency obtained by this method is 0.65 counts/Rn disin. and the detection limit $4 \cdot 10^{-14}$ Ci Rn-222; it is sufficient to measure radon in atmospheric air without charcoal enrichment of radon. The use of transistorized auxiliary instruments/ scaler, HT units/ allows the system to be suitable for out-of-laboratory applications.
Author

N67-14033# California Univ., Livermore. Lawrence Radiation Lab.
SOME RECENT DEVELOPMENTS IN TECHNIQUE FOR MONITORING HIGH-ENERGY ACCELERATOR RADIATION
Joseph B. Mc Caslin, H. Wade Patterson, Alan R. Smith, and Lloyd D. Stephens Aug. 1966 21 p refs Presented at 1st Intern. Congr. of Radiation Protect. Assoc., Rome, 5–10 Sep. 1966 Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-16769; CONF-660920-5) CFSTI: HC $1.00/MF $0.50

In order to accurately evaluate the exposures received by individuals working near high energy accelerators it is necessary to measure the separate components in the radiation field and to determine their energy spectrum. Since no single instrument or detector will do this, a variety of different detectors and instruments must be used. Three recent developments in technique for monitoring particulate radiation above 20 MeV use nuclear emulsion, elemental mercury, and ^{7}Be production in light elements; below 20 MeV, the use of moderated foils of In, Au, and Co has been extended to include Ta. When emulsion is used, the number of stars formed by high-energy inelastic collisions is counted, together with the number of gray prongs. The ratio of gray prongs per star was previously found to be linearly related to the energy of the neutron which formed the star, over the energy range 20 to 300 MeV. This technique is used to measure average neutron energy and to estimate spectrum shape for neutron energies above 20 MeV. A second technique makes use of the spallation of Hg to ^{149}Tb, and alpha emitter of 4.12-hour half-life. The threshold for this reaction is near 500 MeV and it therefore extends the use of threshold detectors for the estimation of spectrum shape to a new energy domain and gives some additional confidence in previous estimates of spectrum shape made with Bi fission, $^{12}C(n,2n)^{11}C$, and $^{27}Al(n,\alpha)^{24}Na$. Thirdly, production of ^{7}Be from ^{12}C, ^{14}N, and ^{16}O was studied; it offers a method of high-energy neutron threshold detection with practical thresholds extending from 30 to 40 MeV for carbon to 45 to 55 MeV for oxygen. The practical sensitivity can be arbitrarily high without making the extraction process either too lengthy or unwieldy. Another recent development involves the inclusion of Ta in the class of detectors which use a thermal-neutron-sensitive activation element inclosed in a Cd-clad hydrogenous moderator to allow an integration period of a few months and a sensitivity considerably greater than with Co. Finally, recent improvements in the performance of our large parallel-plate Bi fission chamber are discussed.
Author (NSA)

N67-14101*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLID-STATE WIDE-RANGE LOW POWER CAMERA TIMER FOR SPACE APPLICATIONS
Joseph C. Thornwall Washington, NASA, Jan. 1967 11 p refs
(NASA-TN-D-3756) CFSTI: HC $1.00/MF $0.50 CSCL 14E

This paper describes a device for timing sequentially 8 film exposures of a rocket-borne camera with a time interval between each exposure to allow the camera film transport mechanism to step the film from one frame to the next after each exposure. Each exposure time can be independently adjusted from a fraction of a second to several hundred seconds by changing the value of a timing resistor and/or capacitor. All of the rocket interface circuits have been designed to minimize the coupling of spurious noise signals into the timer.
Author

N67-14103*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A METHOD OF SLITLESS ABSOLUTE SPECTRAL PHOTOMETRY
Gale A. Harvey (M.S. Thesis–Va. Polytech. Inst., Jun. 1966) Washington, NASA, Jan. 1967 20 p refs
(NASA-TN-D-3765) CFSTI: HC $1.00/MF $0.50 CSCL 14E

A discussion of absolute slitless spectrophotometry for reentry and astronomical radiation measurements is given. A method of photometry intended for 20-percent accuracy for moderate-aperture (5 to 30 centimeters) slitless spectrographs is presented. This accuracy is a factor of 5 reduction in errors over previous absolute spectrophotometry using similar instrumentation for which accuracy statements have been published. The method of photometry has been applied to a spectrogram of the star Vega and has yielded spectral irradiance values, in the wavelength interval from 4200 to 6200 angstroms, with an average deviation of 7.9 percent from values in the literature. The maximum deviation of any of the points, taken at 100-angstrom intervals, was 16.3 percent. Author

N67-14129# California Univ., Berkeley. Lawrence Radiation Lab.
A SIMPLE AND INEXPENSIVE SYSTEM FOR MEASURING CONCENTRATIONS OF ATMOSPHERIC RADON-222
Gary E. Jones and Lowell M. Kleppe 27 Jun. 1966 21 p
(Contract W-7405-ENG-48)
(UCRL-16952) CFSTI: HC $2.00/MF $0.50

A radon-222 sampling system was designed and built which uses a charcoal absorption technique for collecting and analyzing that gas in a simple, inexpensive, reliable way. Results of measurements made with the system, although only preliminary, are in agreement with data obtained by other investigators. Author (NSA)

N67-14133# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
A COMPACT, LOW-COST ALPHA COUNTER
W. H. Tyree 17 Aug. 1966 7 p
(Contract AT (29-1)-1106)
(RFP-777) CFSTI: HC $1.00/MF $0.50

An alpha counter with meter readout is described. The cost of the counter including an air proportional detector and rechargeable batteries is less than $65.00. Author (NSA)

N67-14189# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
HIGHLY SENSITIVE ACCELEROMETER [ACCELEROMETRE A GRANDE SENSIBILITE]
Michel Gay 1966 12 p refs In FRENCH Presented at the 12th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966 Submitted for Publication
(TP-393) CFSTI: HC $1.00/MF $0.50

Following some general considerations on the particularities of highly sensitive accelerometers, the solutions retained are developed. The three-directional accelerometer uses a servo-loop and a capacitance detection of the motion of a ball electro-statically suspended. The prototype has measurement ranges from 7.5×10^{-6} ms^{-2} to values beyond 10^{-6} ms^{-2}. The results already obtained allow considering thresholds in the order of 10^{-9}ms^{-2} with response time of 1.5 sec.
Author (ESRO)

N67-14194# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
THE DEVELOPMENT OF A HIGH SPEED CAMERA OF HIGH RESOLUTION WITH IMAGE ORTHICON TUBE [DIE ENTWICKLUNG EINER KURZZEITKAMERA HOHER AUFLOESUNG MIT DEM IMAGE-ORTHIKON]
W. Hopmann Aug. 1966 62 p refs In GERMAN
(JUL-290-PP) CFSTI: HC $3.00/MF $0.75

The development of a high speed still camera is described, which uses the image section of an image-orthicon television camera tube as high speed photoelectronic shutter. The general problems of using TV-apparatus in high speed photography are discussed. A commercially manufactured closed circuit TV-system was modified for single frame scanning. These modifications and the auxiliary circuits are described. The effects on the resolution of high electron currents in the image section at very short exposure times are estimated and compared with experimental results. The shutter efficiency of the image section is mainly determined by photoelectric emission of the target foil, the reasons of that emission are discussed. For the shutter action of the image section a fast, flat topped pulse of approximately −500 V is required. The circuit of the hard tube pulser is described. The characteristic data of the developed system are: sensitivity: 10,000 ASA; shutter efficiency: 14,000; resolution: 450 TV-lines for 100, 350 TV-lines for 20,200 TV-lines for 10 nsec shuttertime. Pictures of test charts and of applications of the system in plasma physics are given.
Author (ESRO)

N67-14285# Royal Aircraft Establishment, Farnborough (England).
HELIUM MASS-SPECTROMETER LEAK DETECTION
W. N. Mair May 1966 18 p
(RAE-TR-66158) CFSTI: HC $1.00/MF $0.50

The measurements of leaks in vacuum components using helium mass-spectrometers are analyzed mathematically and the necessary conditions for using a simple expression for an integrated burst method of increasing sensitivity, are discussed.
Author (ESRO)

N67-14323# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROCHEMICAL TRANSDUCERS FOR ACOUSTIC SIGNAL RECEPTION AND SMALL-DISPLACEMENT MEASUREMENTS
N. S. Lidorenko, I. N. Moiseyev et al 25 Apr. 1966 12 p refs Transl. into ENGLISH from Electrotekhn. (USSR), v. 38, no. 3, 1965 p 3–5
(FTD-TT-65-1875, TT-66-62438; AD-640297) CFSTI: HC $1.00/MF $0.50

Electrochemical pickups for reception of acoustic signals and measurement of small displacements are described; their basic characteristics are given. Author (TAB)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N67-13367# Vitro Engineering Co., New York.
A FEASIBILITY AND CONCEPTUAL DESIGN STUDY OF THE WOOD-PLASTIC COMBINATIONS PROCESS Progress Report
J. H. Frankfort *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood-Plastic Mater. held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 32–48 (See N67-13361 04-18) CFSTI: $2.00

A feasibility and conceptual design study of the wood-plastic combinations (WPC) process was made. The study indicated that sufficient data have been generated for the design of a pilot plant facility with a 200 lb/hr production rate; recommended a pilot plant that would provide capabilities for development work on other monomer systems—work essential for design of a production facility using these materials; considered the economic factors related to a 3000 lb/hr WPC production plant; and concluded that the market potential for furniture, flooring, and specialty items is excellent. Design features for monomer handling, impregnation, and irradiation equipment as well as research functions for the pilot plant are described. Recommendations and conclusions are presented. Author (NSA)

N67-13392# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WELDING PRODUCTION (SELECTED ARTICLES)
1 Apr. 1966 30 p *refs* Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 4, 1965 p 15–18, 25–28 (FTD-MT-65-151; TT-66-62070; AD-637374) CFSTI: HC $2.00/MF $0.50

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N67-13393# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC WELDING WITH A CONSUMABLE ELECTRODE ON THE VERTICAL PLANE
A. V. Petrov, G. A. Slavin, and M. M. Shtrikman *In its* Welding Production 1 Apr. 1966 p 1–11 *refs* (See N67-13392 04-15) CFSTI: HC $2.00/MF $0.50

Results are presented of an investigation of the peculiarities present in making vertical welds on stainless steel. An automatic method which employs a consumable electrode in a medium of inert gas is used. A description of a welding process developed in the study is included. C.T.C.

N67-13394# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CAUSE OF THE FORMATION OF PORES IN WELDED TITANIUM JOINTS
A. I. Gorshkov *In its* Welding Production 1 Apr. 1966 p 13–25 *refs* (See N67-13392 04-15) CFSTI: HC $2.00/MF $0.50

An examination was made of the influence of hydrogen, nitrogen, oxygen, and air on the formation of pores in welded titanium joints. Also examined was the interaction of the gases among themselves, and their assimilation by the molten pool during argon-shielded arc welding. It was found that the basic cause of porosity is hydrogen which exists in the weld metal and in the arc zone. C.T.C.

N67-13531*# Rai Research Corp., Long Island City, N. Y.
SOME NEW METAL AND METAL-CERAMIC COMPOSITES
Samuel Korman Washington, NASA, 1966 31 p *refs* Sponsored by NASA
(NASA-SP-5060) GPO: HC $0.25; CFSTI: MF $0.50 CSCL 11D

The current state of composites consisting of metal components and metal-ceramic components is reviewed. Various classes of composites are defined on a functional and physical basis, and the thermal effects on structural properties are described. An analysis of the dispersion-strength-ended alloy is presented. Factors affecting the stability and properties of the alloy are listed as: solubility of the dispersed phase in the matrix at elevated temperature, geometric considerations, particle shape and distribution, hardness and strength of the dispersed phase, structural continuity, interfacial energy, stored energy, fracture strength, chemical interactions between the two phases, purity of components, presence of surface films on the particles, and chemical compatibility of components. In addition, a theoretical explanation of dispersion strengthening, the production processes, and commerical applications are delineated. Various properties of fibers, such as tensile strength are discussed. Whiskers are described as the best fiber form, and their cost is mentioned. The possibilities of using ceramic matrices for high-strength high-modulers fiber are enumerated. S.P.

N67-13535*# Chrysler Corp., Huntsville, Ala. Space Div.
E. I. DU PONT DE NEMOURS AND COMPANY PART NUMBER X-696 EXPLOSIVE RELEASE, TEST REPORT
R. S. Endicott 25 Oct. 1966 36 p *refs*
(Contract NAS8-4016)
(NASA-CR-80615; CCSD-FO-1060-3S) CSCL 13E

This report presents the results of acoustic testing conducted on an explosive release part. The test was conducted to determine whether the explosive release could withstand the acoustic levels for launch complexes 34 and 37 without detonating and with no degradation of performance. The results of this test show that the explosive release part will withstand the acoustic levels with no failures or degradation of performance. Author

N67-13543# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
WELDING TECHNIQUES FOR SMALL CAPSULES
F. T. Ewart and R. A. Carney Sep. 1966 7 p *refs*
(AERE-M-1801) HMSO: 2s 6d

A technique is described for producing high integrity welds, in small closely defined areas on irradiation capsules. The method was originally developed for stainless steel; it has now been extended to include molybdenum alloys and tungsten. Author

N67-13569*# Battelle Memorial Inst., Columbus, Ohio.
A REVIEW OF THE LITERATURE ON CLEANING, PICKLING, AND ELECTROPLATING PROCESSES AND RELIEF TREATMENTS TO MINIMIZE HYDROGEN EMBRITTLEMENT OF ULTRAHIGH-STRENGTH STEELS
Special Report
T. P. Groeneveld, E. E. Fletcher and A. R. Elsea 15 Oct. 1966 44 p *refs*
(Contract NAS8-20029)
(NASA-CR-80690) CFSTI: HC $2.00/MF $0.50 CSCL 13H

The results of a literature and industrial survey of low hydrogen embrittling and nonhydrogen embrittling cleaning, pickling, and electroplating processes and of various hydrogen embrittlement relief treatments are reported. Cadmium, chromium, and nickel electroplating processes are covered. Data are tabulated for various pickling processes, agings, tensile strength, static and sustained loading tests, and metal corrosion. N.E.N.

N67-13724 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
GREASE-LUBRICATED SPIRAL GROOVE BEARING FOR A STRAIGHT-THROUGH SHAFT
G. Remmers *In its* Philips Tech. Rev., Vol. 27, No. 3/4 1966 p 107–108 *ref* (See N67-13721 04-34)

A test motor with grease-lubricated spiral groove bearings capable of taking thrust and radial loads has now been running for 15,000 hours without relubrication. This excellent result encouraged the development of a similar bearing for use with straight-through shafts, which are more often met with in practice. The bearing has a combination of groove patterns on the axial and radial bearing surfaces and also two annular spaces which trap the grease forced out of the bearing, and from which the grease is pumped back to the bearing surfaces. It is expected that this design will in many cases replace the relatively expensive and bulky ball bearings. Author

N67-13771 National Engineering Lab., Glasgow (Scotland).
A COMPARISON OF TWO SURFACE FITTING PROGRAMMES FOR NUMERICALLY CONTROLLED MACHINE TOOLS
R. M. Sim Jan. 1966 37 p refs
(NEL-211)

The performance of the PMT2 and APT-FMILL programs are compared for the numerically controlled milling of surfaces specified by coordinates of points on a mesh. As a test, co-ordinates were calculated for points lying on a portion of the surface of a sphere, where it is intersected by a series of concentric cylinders. These data were supplied to the two programs, and the numerical output from the programs was analyzed to show errors from the spherical surface. Specimens were also milled and measured. Part-programming, computing, and machining times were also noted. For this test-piece the computing costs are similar, PMT2 seems quicker to part-program, and APT-FMILL has smaller errors. Further tests are recommended. Author

N67-13782*# Sea-Space Systems, Inc., Torrance, Calif.
DEVELOPMENT OF ULTRA THIN GAUGE POLYMERIC FILMS Final Report, 16 Apr. 1965–10 Aug. 1966
Dale W. Cox, Jr. Sep. 1966 36 p refs
(Contract NAS7-274)
(NASA-CR-72051) CFSTI: HC $2.00/MF $0.50 CSCL 13H

Polyethylene film was extruded consistently in gauges less than 1/10 mil and polypropylene film in gauges less than 1/5 mil. Flexibility and tensile tests of thin films in cryogenic liquids indicated that thin film polyethylene can be used at temperatures down to −423°F. These results contradict generally accepted cold brittle temperature data for polyethylene, based on heavier gauge films. Successful performance of the double orifice die to extrude ultra thin gauge films in gauges below 1/15 mil was not achieved. Although six extruder operations were conducted, problems due to blocking of the films and a very slight movement of the side-fed die barrel under load prevented film gauges less than 0.082 mil from being achieved. Continued attempts to adjust for this loading movement and to inject a suitable anti-block material between film layers were not successful. Changes in physical properties of ultra-thin gauge polyethylene films with time was experienced and investigated. An analysis of these results is presented. Author

N67-13795*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE PRESSURE DISTRIBUTION OF METAL ON THE ROLLS DURING THE ROLLING PROCESS [ISSLEDOVANIYE RASPREDELENIYA DAVLENIYA METALLA NA VALKI PRI PROKATKE]
A. I. Kolpashnikov and A. N. Anufriyev Nov. 1966 11 p Transl. into ENGLISH from Tr. Mosk. Aviats. Tekhnol. Inst. (Moscow), no. 82, 1965 p 83–90
(NASA-TT-F-10422) CFSTI: HC $1.00/MF $0.50 CSCL 13H

The derivation of an equation for stresses developing during rolling, as a function of rolling rate, size of the rolls, geometry of the product, and friction is presented. A preliminary comparison of theoretical and experimental results shows good agreement. Author

N67-13812# RAND Corp., Santa Monica, Calif.
OPTIMAL MAINTENANCE OF STOCHASTICALLY FAILING EQUIPMENT
D. W. Jorgenson, John J. Mc Call, and Roy Radner Apr. 1966 338 p refs
(Contract AF 49(638)-1700; Proj. Rand)
(R-437-PR; AD-632671) Available from RAND Corp., Santa Monica, Calif.: $7.00

A presentation of the theory of maintenance for both deterministic and stochastic problems. For deterministic situations, the theory is straightforward and provides a useful introduction to the theory for stochastic situations. The report gives a treatment on the basic theory of optimal maintenance policy for stochastic problems, and applications of optimal maintenance policies to concrete problems in the maintenance of military systems. The models of maintenance activity underlying these applications are divided into two groups: (1) preventive maintenance models, applied to the maintenance of manned aircraft; (2) preparedness maintenance models, applied to the maintenance of a typical ballistic missiles system. Author (TAB)

N67-13819# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
CLADDING THE INSIDE SURFACE OF A 3 1/4 IN. ID ZIRCALOY-2 PRESSURE TUBE WITH 1S ALUMINUM
R. D. Watson Sep. 1966 19 p refs
(AECL-2617; CRE-1215) CFSTI: HC $1.00/MF $0.50

A hot-press sizing technique has been developed for cladding the inside surface of Zircaloy-2 pressure tubes with 1S aluminum. The process is performed in air with the Zircaloy-2 and aluminum at a temperature of approximately 950°F. A controlled atmosphere is not required, either during preheating or while the cladding is being applied. Tubes 30 inches long and 3-1/4 inches ID have been coated with 1S aluminum in thicknesses ranging from 0.005 inches to more than 0.02 inches; tubes longer than 30 inches have not been attempted. The lining of aluminum is firmly attached to the Zircaloy-2 at all points in the tube but the bond strength varies considerably from 6500 to 28000 lbf/in.² Author

N67-13875*# Honeywell, Inc., Minneapolis, Minn. Aeronautical Div.
EIGHTEEN-INCH DIAMETER EXPULSION DIAPHRAGMS Final Report
Dallas E. Nelson 15 Sep. 1966 41 p Prepared for JPL
(Contract NAS7-100; JPL-950589)
(NASA-CR-80770; Rept.-1383-FR) CFSTI: HC $2.00/MF $0.50 CSCL 13H

This report discusses the efforts and results obtained in two basic areas of investigation in all-metal, positive expulsion diaphragm development. These are: (1) diaphragm recycleability and (2) diaphragm fabrication from stainless steel and titanium. Diaphragm recycleability efforts consisted of a controlled motion mechanism and diaphragm hoop reinforcement. This report treats each of these phases in a separate section, in which background, design, fabrication, and tests are described, followed by conclusions and recommendations. Author

N67-13878*# Mechanical Technology, Inc., Latham, N. Y.
DESIGN AND DEVELOPMENT OF A GAS SUPPLY SYSTEM FOR HERMETICALLY SEALED PLATFORMS
P. W. Curwen 14 Nov. 1966 101 p
(Contract NAS8-11660)
(NASA-CR-80767; MTI-66TR57) CFSTI: HC $4.00/MF $0.75 CSCL 13H

This report describes the design and development of a gas supply system for hermetically sealed platforms. Immediate interest in this system is for future applications of the ST-124 stabilized platform for the Saturn V instrument unit. The gas supply system is composed of (1) a recirculation subsystem which continuously compresses nitrogen from the platform and recirculates it to the gas bearings used in the accelerometers and gyros, and (2) a gas make-up subsystem for feeding nitrogen into the recirculation subsystem at a rate sufficient to match any reasonable leakage rate from the circulating loop to space ambient. The major accomplishment of the program has been development of a unique type of compressor for the recirculation subsystem. Author

N67-13903# Martin Co., Denver, Colo. Center for High Energy Forming.
CENTER FOR HIGH ENERGY FORMING First Annual Report
Aug. 1966 464 p *refs* Prepared jointly with Denver Univ.
(Contract DA-19-066-AMC-266(X))
(CR-65-77; AMRA-CR-66-05/5; AD-637799) CFSTI: HC $7.65/MF $2.00

The report contains surveys of the present state of knowledge of the shock hardening of metals, the dynamic deformation behavior of metals, and a review of experimental techniques for measuring high velocity metals, displacements and high intensity, short duration pressures. It includes a report of the significant analytical work done at the center on the large dynamic plastic deformation of metal blanks under impulsive loading. Author (TAB)

N67-13953# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
COMPARISON OF WEAR RATES IN WATER FROM DIFFERENT TEST MACHINES
J. T. Dunn Aug. 1966 25 p refs
(AECL-2603) CFSTI: HC $1.00/MF $0.50

Wear rates of different material combinations tested as 1/2-in dia, flat-ended riders reciprocating on a flat surface, were found to be the same, or less than, the wear rates of the same combinations tested as 3/4-in journal bearings. Because of this correlation it appears that the extensive wear results obtained with journal bearing specimens can be used, with a reasonable degree of confidence, to predict the maximum wear of flat sliding surfaces in water. This correlation may not hold for surfaces 1/4-in dia and smaller since the wear of small brass riders on stainless steel is stress dependent at contact stresses over 400 lb/in^2 Author

N67-13996# Instytut Elektrotechniki, Warsaw (Poland). Zaklad Radiologii Przeaystowej.
THE DEVELOPMENT OF A STANDARD METHOD FOR TESTING PACKAGING OF RADIOACTIVE MATERIALS FOR LEAKAGE Final Report, 1 Feb. 1964–1 Oct. 1965
Jozef Domanus 1 Oct. 1965 219 p *refs*
(Contract IAEA-251/RB)
(NP-16172; Rept.-3)

The IAEA and ISO directives for the safe transport of radioactive materials prescribe that radiation leakage tests on containers be performed by either autoradiography or radiometry but the field of application of these methods is not defined. Detailed tests of both methods were performed. For the autographic method, high speed X-ray films with Pb intensifying screens gave best results. Characteristic curves are presented that were computed for different thicknesses of Pb that correspond to the thickness of shielding of transport containers and using ^{192}Ir, ^{137}Cs, and ^{60}Co as sources. Measurements were also made on containers with holes drilled to simulate activity released by container rupture. Radiometric investigations were performed using a scintillation counter with one- and 2-in. crystals and different Pb collimators, a portable scintillation counter with three crystals, and a portable ionization chamber dosimeter. Higher detection sensitivity was obtained with the autoradiographic method. Recommendations are presented for standardized tests for leaks in containers used for shipping radioactive materials. NSA

N67-13998# Atomic Energy of Canada, Ltd., Ottawa (Ontario).
PERFORMANCE TESTING OF CONICAL-FACE HIGH PRESSURE ROTARY SHAFT SEALS
R. D. Watson Nov. 1965 36 p refs
(AECL-2551) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

The performance characteristics of a special type rotary shaft seal have been determined at pressures up to 1000 $lbf/in.^2$, gage and speeds to 1900 rev/min. The seal is made up of two rings, with one flat face ring in contact with the very slightly cone-shaped face of the other ring. The channel, which is formed by the two faces in contact, converges in the direction of the leakage flow. The taper on the cone-shaped ring was varied from 0.00032 in./in. to 0.0024 in./in. and the seal characteristics were determined for each different taper. The leak rate of the conical-face seal was found to vary with rotary speed. The larger the ratio of tangential seal velocity to radial leakage velocity the greater the percentage change in leak rate with speed. Concave twisting of a seal produced by pressure induced unbalanced moments on the seal rings has been shown to cause the leak rate of a seal to decrease as the pressure is increased, when normally the reverse is true. For a given set of conditions the leak rate of the conical-face seal was found to decrease with increasing viscosity. At zero speed the leak rate is approximately proportional to the reciprocal of viscosity. When the seals are running this is no longer true because the effect of rotational velocity on leak rate varies with viscosity. Author (NSA)

N67-14024# Sandia Corp., Livermore, Calif.
PRESSING HOLLOW SHAPES FROM HIGH-STRENGTH BERYLLIUM
D. M. Johnson [1966] 20 p
(Contract AT(29-1)-789)
(SCL-DC-66-57) CFSTI: HC $1.00/MF $0.50

Efforts to fabricate and test hollow or shaped pressings from Be powder are discussed. The pressing process was unsuccessful when applied to large frustums, but the possibility of producing Be pressings having a yield strength of 55,000 psi was demonstrated. The feasibility of hollow pressings was demonstrated, and the addition of Si to the Be powder was found to promote sintering at reduced pressure. NSA

N67-14062# Southwest Research Inst., San Antonio, Tex. Dept. of Aerospace Propulsion Research.
FUNDAMENTAL INVESTIGATION OF LIQUID–METAL LUBRICATED JOURNAL BEARINGS Quarterly Technical Report, 1 Apr.–1 Jul. 1966
R. A. Burton and Y. C. Hsu 1 Jul. 1966 40 p refs
(Contract AT(11-1)-1228)
(SWRI-1228-8-24; RS-487; QTR-7) CFSTI: HC $2.00/MF $0.50

Numerical techniques, developed in this program for analysis of finite bearings, are shown to apply to both laminar and turbulent films. Comparisons with exact solutions for tilted pads in laminar flows confirm the accuracy of the approach. Data on leading-edge pressure for tilted pads in the large-scale turbulence apparatus are summarized, and shown to yield to correlation in terms of a leading-edge stagnation pressure. When this relationship is applied in tilted pad performance calculations, negative leading-edge pressure is predicted for small tilt angles, and the accompanying

center of pressure movement is such as to be associated with instability in pivoted pad applications. Author (NSA)

N67-14082# California Univ., Berkeley. Lawrence Radiation Lab.
STRENGTH IN A TWO-PHASE MODEL SYSTEM WITH FIBER REINFORCEMENT
Gerd Einmahl (M.S. Thesis) 2 May 1966 40 p refs
(Contract W-7405-ENG-48)
(UCRL-16844) CFSTI: HC $2.00/MF $0.50

Model systems consisting of a glass matrix reinforced by randomly oriented W or Ni fibers with an aspect ratio of 50 were fabricated by vacuum hot-pressing and tested by bending. The systems were distinguished by interfacial bonding and different thermal expansion coefficients of the matrix and the dispersed phase. In systems that could be densely fabricated the strength was found to increase linearly with increasing volume fraction of fibers. Reversing the sign of the thermal expansion coefficient of the matrix relative to that of the inclusions had little effect on the strength. A greater strengthening effect was achieved in the W-glass systems where an interfacial bond existed as opposed to the Ni-glass series. The strengthening effect of the Ni fibers is explained by gripping of the fiber ends by the glass due to irregularities in shape from the cutting operation used to obtain short fibers. Author (NSA)

N67-14092# IIT Research Inst., Chicago, Ill.
RESEARCH ON ZIRCALOY BRAZE ALLOY DEVELOPMENT Quarterly Report, 1 Apr.–30 Jun. 1966
Z. P. Saperstein 18 Jul. 1966 14 p refs
(Contract AT(11-1)-578)
(IITRI-578-P29-2; IITRI-B6064-2; EURAEC-1679) CFSTI: HC $1.00/MF $0.50

A program was initiated to develop a braze filler alloy and brazing procedure suitable for the fabrication of pressurized water reactor fuel element assemblies. The initial work which was undertaken during the first quarterly period is described. The first experimental effort will involve the preparation and evaluation of a large number of Zr-base binary systems. More complex second-generation alloys will be developed in later stages of the program. Author (NSA)

N67-14105*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADDITIONS TO FUSED-FLUORIDE LUBRICANT COATINGS FOR REDUCTION OF LOW-TEMPERATURE FRICTION
Katherine M. Olson and Harold E. Sliney Washington, NASA, Jan. 1967 21 p refs
(NASA-TN-D-3793) CFSTI: HC $1.00/MF $0.50 CSCL 11H

Although fused-fluoride solid lubricants exhibit low wear and long lives from 70° to 1500°F (21° to 816°C) in air, at low sliding velocities their friction is high at temperatures from 70° to 900°F (21° to 482°C). An experimental program was conducted to reduce this low-temperature friction by the addition of solid lubricants such as molybdenum disulfide (MoS_2) and silver, which are effective at low temperatures. The friction experiments were conducted in air with a pin-on-disk apparatus. Friction coefficients were measured on each coated disk from 70° to 1200°F (21° to 649°C) or higher and back to 70°F (21°C) where applicable. While MoS_2 additions could be used only once because of their oxidation above 750°F (399°C), they did greatly reduce the friction from 70° to 600°F (21° to 316°C). Better results were obtained if MoS_2 was incorporated into the coating rather than applied over the fused-fluoride coating. Silver was added to calcium fluoride–barium fluoride slurries either as reducible silver halides or as elemental silver powder. The friction coefficients of coatings with 35 weight percent silver powder were 0.2 or less at temperatures from 70° to 1400°F (21° to 760°C), and less than 0.3 during cooling to 70°F (21°C). While they reduced low-temperature friction, neither MoS_2 nor silver additions adversely affected the wear of the specimens or the life of the fused-fluoride coatings under the conditions of these experiments. Author

N67-14112*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVEMENT OF A MICROTENSILE MACHINE
Andrew L. Cunningham Washington, NASA, Jan. 1967 6 p refs
(129-03-09-01-22)
(NASA-TM-X-1326) CFSTI: HC $1.00/MF $0.50 CSCL 13I

Modifications of the loading system and traveling optical system of a microtensile machine are described. The motor-driven load micrometer permits constant-rate loading, the recording of stress-strain data, and a significant increase in output of test results. The original traveling microscope is replaced with an optical unit that offers an extensive range of magnifications and the use of optical measuring and photomicrographic devices. Improved observation and measurement of transparent specimen materials can be conducted by employing standard, polarizing, or dark-field microscopy. The improved accuracy in measurement of specimen dimensions provides more accurate test results. The original precision of the instrument and its chief characteristic of high extension sensitivity are maintained. Author

N67-14123# Royal Aircraft Establishment, Farnborough (England).
FACTORS AFFECTING THE ENDURANCE OF RUBBED LUBRICANT FILMS OF LAMELLAR SOLIDS
J. P. Giltrow Jun. 1966 17 p refs
(RAE-TR-66184) CFSTI: HC $1.00/MF $0.50

Experiments have been made, using a pin and ring machine, to measure the influence of surface roughness, humidity, and chemical composition on the endurance of rubbed films of lamellar solids. An optimum film life is exhibited on substrates of roughness approximately 30–40 μ in CLA. An environment of high relative humidity during film formation leads to enhanced endurance whilst high humidity during film testing leads to reduced endurance. The coefficients of friction increase with increasing relative humidity of the environment. It is tentatively suggested that the inability of Group VA metal dichalcogenides to lubricate mild and tool steel may be due to their probably non-stoichiometric composition. Author

N67-14134# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
MIMIC TOOL SETTER
R. A. Larson 17 Aug. 1966 6 p
(Contract AT(29-1)-1106)
(RFP-668) CFSTI: HC $1.00/MF $0.50

The mimic tool setter was designed to set single point tool bits on two-axis numerical control turning machines. The prime design considerations were economy, accuracy, and operational speed. The tool setter retains manual operation, but eliminates operator feel. By retaining manual operation, the cost of the setter is kept low, and reliability is kept high. By eliminating operator feel, accuracy is increased, and operational time is reduced. NSA

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N67-13488# New York Univ., N. Y.
SOME OBSERVATIONS OF THE VERTICAL PROFILE OF WATER VAPOR BY MEANS OF A LASER OPTICAL RADAR

Richard M. Schotland *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 273-283 refs *Its* Geophys. Sci. Lab. Contrib. 41 (See N67-13461 04-14)
CFSTI: HC $8.75/MF $3.50
(Contract DA-36-039-AMC-03411(E))

The theory of the measurement of the vertical profile of atmospheric water vapor utilizing a thermally tuned ruby laser radar is presented. Calculations of the transfer function and the expected signal to noise ratio for a typical system are given. Spectroscopic results of a thermally tuned laser scan through the 6942.37A and 6942.15A water vapor lines are shown. Measurements of the range integrated water vapor profiles are compared with the range variation of the backscattered laser returned signal. Author

N67-14212*# Ohio State Univ. Research Foundation, Columbus. Dept. of Electrical Engineering.
INVESTIGATION OF A FEW SIMPLE MOLECULAR GASES AS A POSSIBLE MOLECULAR LASER MATERIAL
Peter K-L Yin and Said H. Koozekanani 1 Nov. 1966 22 p
(Grant NsG-74-60)
(NASA-CR-80832; Rept.-1093-31) CFSTI: HC $1.00/MF $0.50
CSCL 20E

Some mechanisms of inversion are discussed, and a review, in tabular form, is presented on some of the simple molecular gases which have energy levels close to the vibrationally excited metastable level (v = 1) of N_2. It is pointed out that the vibrational level of N_2 is about 2330 cm^{-1} above the ground level and is a metastable state. Because of its long lifetime, it is considered a suitable gas for transferring its energy to other gases being in resonance with it. M.G.J.

N67-14312# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET QUANTUM ELECTRONICS RESEARCH Surveys of FOREIGN SCIENTIFIC AND TECHNICAL LITERATURE
Yuri Ksander 2 Aug. 1966 124 p refs Comprehensive Rept.
(ATD-66-97)

A statistical review of Soviet facility-personality activity in quantum electronics research is presented. The review is divided into sections, each covering the work of a particular research institute, laboratory, or university. The review sections are followed by 634 references to all retrieved sources. The references are arranged in the order in which they are discussed in the sections and are keyed to the appropriate section by letter designation. An attempt is made to show the association of the research teams or groups with their subject of specialization and also to show changes that have occurred in Soviet laser research since Sept 1964. Such changes include shifts in subject areas of interest, volume of work in a given area, and personnel engaged in a given study. The appendices include a subject-facility distribution, the percentage of total retrieved articles by facility and by subject, and an author index. R.N.A.

N67-14331# Army Electronics Labs., Fort Monmouth, N. J.
INTERFEROMETRIC PHOTOGRAPHIC TECHNIQUES FOR RECORDING OPTICAL PATH LENGTH VARIATIONS IN PUMPED LASER RODS
Charles J. Bickart Aug. 1966 28 p refs
(ECOM-2751; AD-640439) CFSTI: HC $2.00/MF $0.50

The report describes some unique photographic techniques developed during an investigation of thermal effects occurring in solid-state laser materials (Nd(+++) glass and ruby) during the pumping period. An experimental approach is described for the investigation of the interaction of a high energy laser beam with the atmosphere. Two novel high-speed cameras designed specifically for these investigations are discussed in detail. Experimental results are shown from which conclusions concerning optimum pumping arrangements, rod characteristics, and doping concentrations can be drawn. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N67-13379# Bettis Atomic Power Lab., Pittsburgh, Pa.
FATIGUE PROPERTIES OF IRRADIATED PRESSURE VESSEL STEELS
W. G. Gibbons, A. E. Mikoleit, and W. J. O'Donnell Jun. 1966 46 p refs Presented at the ASTM Symp. on the Effects of Radiation on Structural Metals, Atlantic City, 29 Jun.–1 Jul. 1966
(Contract NObs-90029)
(WAPD-T-1864; CONF-660627-2) CFSTI: HC $1.00/MF $0.50

The effects of neutron irradiation on the unnotched strain-cycled fatigue properties of pressure vessel steels were evaluated. Two heats of A302 low alloy steel and one heat of A212B C-Si steel were investigated. Results from room temperature tests on non-irradiated material were compared with those from material irradiated up to 8×10^{19} nvt>1 MeV (1.6×10^{23} Dt). The fatigue notch sensitivities of these materials were also investigated using V-notch specimens with two and ten mil root radii respectively. Results were compared with theoretical predictions based on the δ theory of fatigue notch sensitivity. Author (NSA)

N67-13597# National Engineering Lab., Glasgow (Scotland).
STRESS-RELAXATION TESTS WITH ELASTIC FOLLOW-UP ON BOLT STEELS
M. F. Day and F. R. Ferguson Jan. 1966 16 p refs
(NEL-212)

Conventional stress-relaxation tests used to assess the strength of bolt steels for flange assemblies in high temperature plant do not take into account the effects of the flange elastic follow up. In this investigation a modified form of test-piece has been used to simulate this effect. Results of tests on several bolt steels indicate only slight increases in residual stress levels. Author

N67-13622# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MELTING POINTS OF HYPOSTOICHIOMETRIC URANIUM DIOXIDE
J. Lambert Bates Jun. 1966 5 p refs
(Contract AT(45-1)-1830)
(BNWL-224)

Melting points were measured for hypostoichiometric $UO_{2.00}$ to $U_{1.67}$. The melting points decrease with decreasing O:U ratio below 2.00, and the data suggests a possible maximum in the melting point curve between $UO_{2.00}$ and $UO_{1.93}$. NSA

N67-13632# General Motors Corp., Indianapolis, Ind. Allison Div.
INVESTIGATION OF BIMETALLIC LIQUID METAL SYSTEMS Progress Report, 1 Feb.–31 May 1966
C. L. Walker and F. G. Myers 20 Jun. 1966 66 p refs
(Contract AT(30-1)-3643)
(EDR-4719; GMAD-3643-5)

Examination and analysis of material from bimetallic (AISI 316 SS and Nb-1% Zr) liquid K systems are being conducted. These systems operate between 1200° and 1500°F for times up to 8000 hr. Results to date indicate that phase changes in the AISI 316 SS involve formation of complex carbides ($Cr_{23}C_6$) and chi

phases. Stress rupture testing of loop-exposed specimens shows a decrease in this property. Low cycle fatigue testing is proceeding. N_2 gradients in the stainless steel containment were obtained and are providing the basis for kinetics analyses of N_2 transport. No area of outward diffusion of N_2 through the stainless steel was found. Detailed chemical and metallurgical analyses of a loop which operated for 8000 hr is also being used for kinetics analysis of N_2, C, and O_2 transport. Preliminary results of kinetics correlations show diffusion coefficients for C in stainless steel to be at least an order of magnitude greater than those in the refractory alloy. Qualitative examination of air-side surfaces indicated no catastrophic oxidation of stainless steel surfaces when surface temperatures did not exceed 1500°F. Ni fins became embrittled (probably due to O_2 diffusion) after 8000 hr of operation at 1400° to 1500°F. Author (NSA)

N67-13654# Oak Ridge National Lab., Tenn.
CREEP-RUPTURE PROPERTIES OF TUNGSTEN AND TUNGSTEN-BASE ALLOYS
H. E. Mc Coy Aug. 1966 51 p refs
(Contract W-7405-ENG-26)
(ORNL-3992) CFSTI: HC $3.00/MF $0.50

The creep-rupture properties of two types of unalloyed W and two W-base alloys were determined at 1650° and 2200°C for times of at least 500 hr. The materials studied were wrought powder-metallurgy W, several lots of thermochemically deposited (TCD) W, W–2% ThO_2, and Sylvania A (W–0.5% Hf–0.02%C). At 1650°C, the order of strengths from the greatest to least was W–2% ThO_2, Sylvania A, and TCD and powder-metallurgy W. At 2200°C the order of strengths from greatest to least was W–2% ThO_2, TCD and powder-metallurgy W, and Sylvania A. The ductility of the TCD W was low at 1650°C, but was good at 2200°C. The W–2% ThO_2 showed moderate ductility at both temperatures. The ductility of the Sylvania A improved from moderate at 1650°C to good at 2200°C. The powder-metallurgy W had good ductility at both test temperatures. All of the materials studied exhibited better high-temperature grain-size stability than the powder-metallurgy material. Voids formed in the TCD W at 2200°C and grew to quite large sizes under an imposed stress. These voids were thought to be associated with impurities. Author (NSA)

N67-13659# Argonne National Lab., Ill.
ELASTICITY AND ANELASTICITY OF URANIUM OXIDES AT ROOM TEMPERATURE
Roberto J. Forlano, Alfred W. Allen (Ill. Univ.), and Robert J. Beals Dec. 1965 75 p refs
(Contract W-31-109-ENG-38)
(ANL-7101) CFSTI: HC $3.00/MF $0.75

The elastic modulus of sintered compacts of stoichiometric uranium oxide at room temperature increases with increasing density. When the volume-fraction porosity is less than 0.1, either a linear or an exponential equation can be used to calculate the elastic trait as a function of density. When the volume-fraction porosity becomes greater than 0.1, a linear equation seems to be most suitable. The linear expression is given by $E = 2233.85(1-2.277P)$, and the exponential equation by $E = 2243.56e^{-2.52P}$; where E is the elastic modulus of porous polycrystalline uranium oxide, and P is the volume-fraction porosity. The elastic modulus of stoichiometric, nonporous uranium dioxide at room temperature was found by extrapolation to be 2243.56 ± 22.1 kilobars when the exponential equation was used, and 2233.85 ± 22.05 kilobars when the linear expression was used. Internal friction of $UO_{2.00}$ decreased sharply as the grain size increased. Other microstructural characteristics, namely, number, size, and position of pores also contribute to this behavior. In nonstoichiometric urania, the presence of a two-solid phase is the pre-eminent factor dictating the damping properties at room temperature. Young's modulus for nonstoichiometric uranium oxide at room temperature depends mainly on the history of the sample. Varying the oxidation and/or the rate of cooling will produce completely different results. When studying or specifying the elastic or anelastic trait of nonstoichiometric urania at room temperature, one must characterize the material not only by the oxygen-to-uranium atom ratio, but also by microstructure, particularly the number, location, and quantity of solid phases present and the type of porosity. In the oxidation range studied here, the ratio of UO_{2+x} to U_4O_9 (or U_4O_{9-y}) is advisable to relate properties at room temperature to uranium-oxygen content. Author (NSA)

N67-13671*# Martin Co., Orlando, Fla.
INTERMOLECULAR BONDING OF VARIOUS METALS AND ALLOYS BY THERMOCHEMICAL VAPOR DEPOSITION Final Report, 15 Apr. 1965–31 Oct. 1966
R. Wilson Nov. 1966 145 p refs
(Contract NAS8-20096)
(NASA-CR-80721; OR-8580) CFSTI: HC $4.00/MF $1.00 CSCL 11F

A four-phase program was directed toward the intermolecular bonding of various metals and alloys by thermochemical vapor deposition (TCVD) at temperatures below the recrystallization point. The four phases were: (1) joining aluminum alloy 2219-T87 with TCVD aluminum; (2) joining stainless steel alloy 321 with TCVD nickel–iron–carbon alloys; (3) joining titanium alloy 8Mo-IV-ICo from the TCVD of inorganic or organic compounds; and (4) joining beryllium alloys from TCVD of suitable inorganic or organic compounds. Described are TCVD plating compound characteristics; environmental control; substrate material, joint geometry, and heating; and carbonyl vapor generation, flow, and control. Results indicate that the thermochemical vapor deposition joining of aluminum, stainless steel, and titanium is feasible; high quality TCVD deposits of aluminum and nickel–iron–carbon alloys were found to be suitable as coatings. K.W.

N67-13772 National Engineering Lab., Glasgow (Scotland).
DIRECT-STRESS CUMULATIVE FATIGUE DAMAGE TESTS ON MILD-STEEL AND ALUMINUM ALLOY SPECIMENS
K. J. Marsh Nov. 1965 54 p refs
(NEL-204)

Direct-stress program loading fatigue tests were carried out on plain polished aluminum alloy and notched mild-steel specimens to investigate the concept of the hypothetical stress/endurance curve as a means of fatigue-life prediction. The results show that in general this concept can provide a more accurate life prediction than the conventional Palmgren–Miner rule, but that the slope of the hypothetical curves applicable to more complex stress blocks cannot always be derived from the results of simple two-level stress block tests. Author

N67-13838*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF MECHANICAL PARAMETERS IN HOT ROLLING [ISSLEDOVANIYESILOVYKH PARAMETROV PRI GORYACHEY PROKATKE]
O. I. Kachaynik Nov. 1966 13 p refs Transl. into ENGLISH from Tr. Mosk. Aviats. Tekhnol. Inst. (Moscow), no. 62, 1965 p 91–100
(NASA-TT-F-10421) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Investigation of the hot rolling behavior of ingots of a Ti-based alloy with additions of Al, V, Mo, and Zr. Tselikov's equation is used to determine the friction coefficients from the mean values of the specific pressure. Toughness and tensile strength were determined for various temperatures, rolling rates, and degrees of deformation. The optimum rolling temperature is given as 800 to 1000°C. Author

N67-13851 Martin Co., Baltimore, Md. Research Dept.
THE INFLUENCE OF ENVIRONMENT ON THE MECHANICAL BEHAVIOR OF METALS
I. R. Kramer and S. E. Podlaseck *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 167–183 refs (See N67-13842 04-12)
(Contracts AF 49(638)-946; AF 33(657)-10509)

Gaseous constituents normally found in the atmosphere affect the plastic deformation characteristics of metals. Modification of the creep and tensile behavior of metal single crystals and polycrystalline metals ranging from high purity to complex alloys are reported. In general, the presence of a solid film, such as an oxide or nitride layer, tends to increase the work-hardening rate and creep resistance of metals. Vacuum or an inert environment will generally cause plastic flow to occur more readily. The fatigue life of metals which can readily form oxide coatings is increased when specimens are tested in the absence of reactive gases. Generally, the extent of improvement in fatigue life decreases as the maximum stress amplitude and the frequency are increased. Small variations in the partial pressures of chemically active gases are shown to cause large changes in the mechanical properties of metals. Author

N67-13871# Library of Congress, Washington, D. C. Aerospace Technology Div.
ASSESSMENT OF SOVIET RESEARCH AND DEVELOPMENT OF WELDABLE ALUMINUM ALLOYS Surveys of Foreign Scientific and Technical Literature
Michael Slesarenko 31 Aug. 1966 58 p refs
(ATD-66-108)

The report discusses the weldability of the alloys, primarily with respect to inert-gas tungsten-arc welding (TIG) and the inert-gas metal-arc welding (MIG), and describes Soviet research work on improving the weldability of existing aluminum alloys and on developing new alloys with better strength and welding characteristics. Author

N67-13879*# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
MATERIALS DATA HANDBOOK, ALUMINUM ALLOY 7075
John Sessler and Volker Weiss, ed. Aug. 1966 159 p refs
(Contract NAS8-11345)
(NASA-CR-80764) CFSTI: HC $5.00/MF $1.00 CSCL 11F

This handbook presents a comprehensive summary of the materials property information presently available on the 7075 alloy. The scope of the information includes physical and mechanical property data at cryogenic, ambient and elevated temperatures, supplemented with useful information in such areas as material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and joining techniques. Design data are presented, where available, and these data are complemented with information on the typical behavior of the alloy. Author

N67-13971# General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.
STAINLESS STEEL FAILURE INVESTIGATION PROGRAM Quarterly Progress Report, Jan.–Mar. 1966
R. N. Duncan, comp. Apr. 1966 42 p refs Submitted for Publication
(Contract AT(04-3)-189)
(QPR-4; EURAEC-1633; GEAP-5150) CFSTI: HC $2.00/MF $0.50

Corrosion testing of high-purity austenitic alloys with controlled impurity additions in HNO_3+Cr^{+6} indicated that Si is of major importance in determining the intergranular corrosion resistance of austenitic alloys. The C additions also affect the intergranular corrosion resistance but is highly dependent on heat treatment prior to testing. The Mn was shown to have very little effect. Measurements of the anodic polarization characteristics of austenitic tricrystals indicate that the rate of dissolution of the grain bouridary is nearly two orders of magnitude higher than the rate of dissolution of the grain centers. Corrosion tests performed in irradiated type-304 stainless steel cladding samples in aqueous $FeCl_2$ at 650°F (0.1 g/1) indicates that irradiation increases the susceptibility of the stainless steel to intergranular attack. Fuel cladding from fuel rods fabricated by co-extrusion showed less susceptibility, in either irradiated or non-irradiated condition, than any other cladding when tested in aqueous $FeCl_2$ at 650°F. A neutron activation analysis technique for chloride in a sample of corrosion product from a reactor was developed. Electrochemical corrosion studies of stainless steel were extended to 300°C. Potentiostatic curves were obtained on various type-304 stainless steel samples. Intergranular attack of stressed type-304 stainless steel samples occurred at 650°F in HCl and NaCl solutions in addition to the $FeCl_2$ solution. Room temperature H_2 embrittlement tests were completed. The tests were inconclusive as to the role H_2 may play in the intergranular failure of type-304 stainless steel fuel rod cladding. Author (NSA)

N67-13972# Organization for Industrial Research, TNO, The Hague (Netherlands).
A NEW DETERMINATION OF THE EMBRITTLEMENT IN STEEL USING SMALL SPECIMENS (≈0.22cc) IN PARTICULAR WITH RESPECT TO IRRADIATION Progress Report, 1 Jan.–31 Mar. 1966
H. C. van Elst 14 Apr. 1966 25 p refs Submitted for Publication
(Contract EURATOM-060-64-11-TEEN)
(EUR-2830; EURAEC-1617) CFSTI: HC $1.00/MF $0.50

The determination of the embrittlement of pressure vessel steels, such as T_1 (U.S.S.), Soudotenax (Cockerill–Ougrée), HSB 55 C (PHOENIX Rheinrohr) and 1.2 MD 07 (Creusot) after increasing neutron radiation doses at 80°C was continued. Series of small samples of these steels irradiated with fluxes of 1×10^{18} to 13×10^{18} n/cm^2 were tested by stress wave attenuation. In the ductile region a decrease of energy absorption after irradiation occurred. The shift in the brittle-ductile region was nuclear owing to a remaining finite slope of the energy-absorption-versus-temperature curve outside transition region and to the decrease of this slope within the transition region, which causes a blurring of the transition phenomenon of the steel. After a neutron dose of 12.571×10^{18} n/cm^2, the energy absorption for T_1-steel was about constant at increased temperature and smaller than in the unirradiated brittle state. Such behavior is also sometimes found at notch impact testing of steel after severe shockloading. After the smaller neutron doses, an increase of energy absorption in the brittle region was observed with the HSB 55-steel. Author (NSA)

N67-13979# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy.
TRASNFORMATION CHARACTERISTICS OF ZIRCONIUM–NIOBIUM ALLOYS Interim Technical Report
P. E. Yaffe, A. J. Perkins, and R. F. Hehemann 31 Jul. 1966 27 p refs Submitted for Publication
(Contract AT(11-1)-588)
(ITR-9; COO-588-12) CFSTI: HC $2.00/MF $0.50

Transmission electron microscopy was used to investigate the formation of athermal and isothermal omega in a series of Zr-Nb alloys. Athermal omega in a quenched 12% Nb alloy exists as discrete platelets parallel to {112} beta planes and approximately 150Å in dia and 20 to 40Å thick. These platelets are arranged in a periodic fashion in (110) beta directions. A modulated structure rather than discrete particles characterizes athermal omega in a 17% Nb alloy and corresponds to what has been termed in the literature diffuse omega. This structure is replaced by periodically

arranged discrete particles during aging. A preliminary study of low temperature aging of a 50% Nb alloy, which does not form omega on quenching, provides evidence for segregation within the beta phase and concurrent formation of diffuse omega in regions of low Nb content. Author (NSA)

N67-13981# Commisseriat a l'Energy Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

STUDY OF POINT DEFECTS IN PURE IRON BY MEANS OF ELECTRIC RESISTIVITY [ETUDE AU MOYEN DE LA RESISTIVITE ELECTRIQUE DES DEFAUTS PONCTUELS DANS LE FER PUR]

Colette Minier-Cassayre (Ph.D. Thesis—Grenoble Univ., 1965) 1966 74 p refs In FRENCH
(CEA-R-2905)

The production, observation, and the annealing of point defects in metals are reviewed and the present state of research is discussed. The techniques employed to produce point defects at low temperatures such as irradiation, quenching, and cold-work, are also discussed, and results of studies of their migration and annealing are reported. The experimental results obtained for pure Fe and for Fe containing impurities are presented. A model is suggested which explains the different stages of annealing observed, and their properties. The energies of interaction between point defects are compared with the values deduced from the theory of elasticity. Author (NSA)

N67-13986# Argonne National Lab., Ill.

NEUTRON DIFFRACTION STUDY OF ORDERED Ni–Mn ALLOYS [NEITRONOGRAFICHESKOE ISSLEDOVANIE UPORYADOCHENNYKH SPLAVOV Ni–Mn]

S. K. Sidorov and A. V. Doroshenko Aug. 1966 16 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 20, issue 6, 1965 p 850–859
(ANL-TRANS-344) CFSTI: HC $1.00/MF $0.50

It was shown that the observed concentration dependance of the mean magnetic moment per atom of ordered Ni–Mn alloys can be explained starting from the concept of a paired mutual interaction of the atoms of the components. This permitted a formulation of conclusions concerning the dependence of the degree of the long-range order and of the correlation in Ni–Mn alloys for a prolonged period of time on the Mn content. A gradual transition from the ferromagnetic to the antiferromagnetic state appears to take place with the increase of the Mn-content in the alloy from 25 to 50 at.% via a system of noncollinear magnetic structures. NSA

N67-14025# Union Carbide Corp., Tonawanda, N. Y. Linde Corp.

RESEARCH AND DEVELOPMENT IN A THERMAL INSULATION STUDY Quarterly Progress Report, Apr.–Jun. 1966

W. D. De Witt 28 Jul. 1966 94 p refs
(Contract AT(30-1)-3632)
(ALO-3632-4) CFSTI: HC $3.00/MF $0.75

The insulation materials study to evaluate the use of Al, Cu, and Ni foils as thermal radiation shields was completed, and a parametric study showing foil life as a function of operating temperature with foil thickness as a parameter is presented. This study showed that for a mission life of 1 to 5 yr the use of Ni foil at 1700 to 1800°F is questionable. Ta foil was recommended as a substitute for Ni at these temperatures, and the feasibility of producing Ta flake opacified spacer as a substitute for Ni flake opacified spacer is being investigated. Experiments evaluating potential foil cleaning techniques for Al, Cu, and Ni foils were completed, and a Linde foil cleaning process was selected. A data survey of the properties of the candidate spacer materials was completed, and a laboratory analysis for residual C content of these materials—in the as-received condition—with the exception of the metal flake opacified spacers was completed. A theoretical study based on reaction rate and mass transfer phenomena was carried out to investigate the processing of candidate spacers. Experiments based on this work were conducted; and a correlation relating processing time, processing temperature, oxidizer gas concentration, spacer C content, and exhaust gas stream CO_2 concentration was developed. Physical stability testing was begun, and experiments were performed on quartz fiber cloth and quartz fiber paper candidates. An offgassing test apparatus was assembled and testing was initiated. Fabrication of the thermal conductivity test apparatus, and fixtures for the insulation preliminary vibrational tests has begun. The vacuum enclosure materials study disclosed three potential problem areas: the permeation of super alloys by air components at elevated temperature, the vaporization of high vapor pressure constituents of the super alloys during long-term exposure to elevated temperature, and intergranular oxide penetration. Author (NSA)

N67-14065# Tennessee Univ., Knoxville. Dept. of Chemical and Metallurgical Engineering.

APPLICATION OF ADIABATIC CALORIMETRY TO METAL SYSTEMS Progress Report, 1 Sep. 1965–31 Aug. 1966

E. E. Stansbury and C. R. Brooks Jun. 1966 36 p refs
(Contract AT(40-1)-3291)
(ORO-3291-3) CFSTI: HC $2.00/MF $0.50

Development of equipment and methods for calorimetry are summarized. Data on the specific heat of Cu obtained using a Ni-component calorimeter are included along with data from the literature on Cu specific heat. Data and discussion are presented concerning specific heat, electric properties, and phases of Mo–Ni alloys and Ni_4Mo. Data on the specific heat of Cu_3Au are included. Phase studies of Ti–Zr alloys were conducted and data concerning phases are presented as shown by electric conductivity. NSA

N67-14076# Syracuse Univ. Research Inst., N. Y. Dept. of Chemistry.

PHASE EQUILIBRIA AND SPECIFIC VOLUMES OF LIQUID METALS AND ALLOYS Progress Report, 1 Aug. 1965–31 Jul. 1966

Frank A. Kanda May 1966 83 p refs
(Contract AT(30-1)-2731)
(NYO-2731-7; Rept.-5) CFSTI: HC $3.00/MF $0.75

Investigations were conducted to extend results already obtained and to obtain values on systems not previously studied. Results are presented from studies of Na–Li immiscibility regions. Data on densities of liquid Na–Li alloys as a function of composition and temperature are included. Data and information are also included on densities and intermetallic compounds formed in liquid Cd–Sb alloys. Other data are included on densities of liquid Bi–Te and Tl–Te systems including possible telluride structures. Results of developmental work on viscometers for use in liquid metal investigations are summarized. Design and operation of distillation apparatus for preparation of high-purity Ca is described. Investigation of the properties and structure of Mg–Sr intermetallic compounds are reported. NSA

N67-14066# General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.

MECHANICAL PROPERTY CHANGES IN ZIRCALOY-2, INCONEL AND INCOLOY FOR NEUTRON EXPOSURES TO 2.5×10^{21} NVT (ABOVE 1 MeV)

D. H. Coplin, M. F. Lyons, T. J. Pashos, and B. Weidenbaum Jun. 1966 40 p refs
(Contract AT(04-3)-189)
(GEAP-5100-9; EURAEC-1681) CFSTI: HC $2.00/MF $0.50

Tensile coupons of Zircaloy-2, Incoloy-800, and Inconel-600 were irradiated at 180°C to a maximum integrated fast neutron flux of 2.5×10^{21} nvt (E>1 MeV). These samples were then tensile tested at 24°C, 316°C, and 593°C. The results of the tensile tests in terms of yield strength, ultimate strength, and uniform and total elongation are presented as a function of exposure. Empirical equations are derived to describe the changes in yield strength with exposure. Author (NSA)

N67-14094# Institut de Recherches de la Siderurgie, Saint-Germain-en-Laye (France).
STUDY OF THE BASE METAL INTENDED FOR RESEARCH ON THE BRITTLE FRACTURE OF LARGE WELDMENTS Technical Report, 1 May 1965–30 Apr. 1966
30 Apr. 1966 31 p
(Contract EURATOM-031-64-TEEF (RD))
(EURAEC-1669; TR-2) CFSTI: HC $2.00/MF $0.50

Results of studies concerning super Elso Ni–Cr–Mo steel revealed that the optimal stress-relief treatment corresponds to a residence time of 2 hr at 600°C. It was also found that the use of fast heat cycles decreases the critical quench rate and has a small effect on transformation. Studies of Mn–Mo–V Ammo steels are reported on composition, dilatometry, quenching, and tensile properties. Tests to determine brittle fracture strength are reported along with results of structural transformation studies. NSA

N67-14095# Centre National de Recherches Metallurgiques, Liege (Belgium). Division Application des Metaux.
A STUDY OF PLASTIC FATIGUE EMBRITTLEMENT OF REACTOR VESSEL STEELS Quarterly Report No. 9
May 1966 32 p ref
(Contract EURATOM-005-63-12-TEEB)
(EURAEC-1624; EUR-2837; P/94/66) CFSTI: HC $2.00/MF $0.50

Research concerning the effects of small amplitude deformations on fatigue of pressure vessel steels is summarized. Results are included on plastic fatigue to breaking point, and brittleness after fatigue at 20 and 300°C. It is concluded that first embrittlement occurs at low fatigue damage. Discussions of embrittlement mechanisms are included. NSA

N67-14096# Materials Research Lab., Inc., Richton Park, Ill.
FRACTURE TOUGHNESS OF REACTOR PRESSURE VESSEL STEELS. DEVELOPMENT OF TEST PROCEDURES, JUNE 1, 1966 TO JULY 31, 1966
E. J. Ripling and Phillip Crosley 15 Aug. 1966 8 p
(Contract AT(11-1)-1477)
(COO-1477-5) CFSTI: HC $1.00/MF $0.50

Fracture toughness testing procedures are being developed to evaluate the toughness of medium strength steels such as A 302 B at room temperature. Impulsive loading (a triangular displacement pulse of approximately 100 milliseconds) is being used. Using this procedure, room-temperature initiation toughness is found to be slightly higher in two-inch thick than in one-inch thick specimens. The arrest toughnesses for the two are essentially identical however. These data indicate that valid toughness can be measured at room temperature in reasonable sized specimens. The use of smaller specimens and higher loading rates will be investigated. NSA

N67-14116# Royal Aircraft Establishment, Farnborough (England).
A STUDY OF THE SIZE EFFECT IN THE PLATING EMBRITTLEMENT OF HIGH STRENGTH STEELS
H. C. Davis and Josephine A. Gray Jun. 1966 20 p refs
(RAE-TR-66168) CFSTI: HC $1.00/MF $0.50

The report describes sustained load tests made on cadmium plated notched (K_t=3.2) specimens 1/4 in and 1 in diameter. Two steels were studied, En 24 and NCMV heat treated to 120 ton/in^2 TS. The results showed that En 24 was very susceptible to plating embrittlement, the maximum stress for unlimited life being in the region of 43 ton/in^2 (30% NTS). NCMV steel was found to be less sensitive having a corresponding value of 62–70 ton/in^2 (40 to 45% NTS). Comparative tests on NCMV steel showed no significant difference between the lives of large and small specimens. In determining the life under sustained load, a minimum testing time of 500 hr was found to be necessary. Author

N67-14126# Rocket Propulsion Establishment, Westcott (England).
THE EFFECT OF PRE-STRAINING ON THE TENSILE PROPERTIES OF STAINLESS STEEL EN58B AT 20° C AND −196° C
P. Midgley Apr. 1966 26 p refs
(RPE-TR-6613) CFSTI: HC $2.00/MF $0.50

The effect of pre-straining an austenitic stainless steel to produce a structural transformation from austenite to martensite with resulting increase of tensile strength has been known for some time. In the investigation reported here the effect of pre-straining stainless steel En58b at room temperature and at the temperature of liquid nitrogen (−196°C) on the tensile properties at room temperature and −196°C has been studied to determine whether because of the increase of tensile strength it is possible to apply the technique of stretch forming to rocket motor structures. Author

N67-14138# California Univ., Livermore. Lawrence Radiation Lab.
CATHODIC ETCHING TO PREPARE RADIOACTIVE SAMPLES FOR OXYGEN DETERMINATION
John H. Hill, C. J. Morris, and Jack W. Frazer 18 Apr. 1966 6 p 18 Apr. 1966 6 p refs
(Contract W-7405-ENG-48)
(UCRL-14959) CFSTI: HC $1.00/MF $0.50

A cathodic etching method was developed to clean the surfaces of radioactive metal samples prior to oxygen determinations. The sample becomes the cathode in a low pressure argon ion discharge. The argon ions bombard the surface of the sample and remove the oxide film by an etching process. The oxygen content of ^{238}U samples cleaned by cathodic etching is consistently lower than the oxygen content of samples cleaned by either acid etching or filing. In addition, the hazards of radioactive contamination are minimized because the sputtered metal deposits on surfaces inside the etcher assembly. Author (NSA)

N67-14163# Royal Aircraft Establishment, Farnborough (England).
EFFECTS OF 0.25% SILICON ON PRECIPITATION PROCESSES IN AN ALUMINUM-2.5% COPPER-1.2% MAGNESIUM ALLOY
R. N. Wilson, D. M. Moore, and P. J. E. Forsyth Feb. 1966 21 p refs
(RAE-TR-66063) CFSTI: HC $1.00/MF $0.50

The effects of adding 0.25% silicon to an Al-2.5% Cu-1.2% Mg alloy have been studied. The rate of formation of GPB zones was less in the silicon-bearing alloy and the size and density of the S' precipitates were also modified, silicon producing a more homogeneous and finer distribution of small precipitates. Similar results were obtained by adding 0.25% Si to an Al-2.5 Cu-1. Mg-1 Ni-1Fe alloy. The mechanical properties of the alloys after aging at room temperature or at 190°C were improved when silicon was present. These effects are discussed in terms of an increase in the solute-vacancy binding energy in the silicon-bearing alloys. Author

N67-14209* # Stanford Univ., Calif. Dept. of Material Science.
MECHANISMS OF STRENGTHENING AND FRACTURE IN COMPOSITE MATERIALS Fifth Progress Report, Jun. 1–Nov. 30, 1966
A. S. Tetelman 30 Nov. 1966 7 p
(Grant NsG-622)
(NASA-CR-80834; PR-5) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Research activities performed during this period included investigations of the effect of drilled holes on the notch toughness of iron base alloys; fracture mechanisms in quenched and tempered steel; elastic properties, strength levels, and fracture mechanisms in TiC–Ni–Mo cermets; problems involving stress concentrations in two phase composite materials using the method of continuously distributed dislocations; and the behavior of elastic–plastic cracks in a two phase system. R.N.A.

N67-14269# Aeon Labs., Egham (England).
SOME FACTORS AFFECTING THE METALLURGICAL MICROSTRUCTURE AND CREEP PROPERTIES OF THE TITANIUM 3Al 6Sn 5Zr 0.5Si TYPE OF ALLOY
C. R. Mayo, Patricia A. Dow, W. K. Armitage, and M. A. P. Dewey Pinnar, Min. of Aviation, Jul. 1966 26 p refs
(Contract KS/1/293/CB.43(a)2)
(S&T-Memo-8/66) CFSTI: HC $2.00/MF $0.50

The results are given of optical and electron metallographic studies of the microstructure of Ti 3Al 6Sn 5Zr 0.5 Si type alloy (Hylite 55) and Ti 3Al 6Sn 5Zr 2Mo 0.5 Si type alloy (Hylite 60) containing 0.005 wt%, 0.42 wt% and 0.75 wt% Si after β annealing treatments at 1000°C followed by either air cooling or water quenching from room temperature and then aging for 24 hours at 500°C. The creep properties of these alloys were determined by testing at 500°C and 18 ton/in.^{2} for approximately 1000 hours. Author (ESRO)

N67-14328# National Academy of Sciences—National Research Council, Washington, D. C. Materials Advisory Board.
INFORMAL STUDY AND RECOMMENDATIONS REGARDING CORROSION
Aug. 1966 14 p
(Contract DA-49-083-OSA-313)
(MAB-227-M; AD-640055) CFSTI: HC $1.00/MF $0.50

A broad look was taken of the corrosion problem in order to recommend whether or not a deeper study by another committee was needed. There was agreement as to the unsatisfactory manner in which current corrosion problems are usually handled, and regarding the inadequate training of engineers. The formation of a group to provide documentation on a number of specific items, which are listed, was strongly recommended. The topics requiring such study include a summary of the major corrosion problems, our capabilities for attacking corrosion problems, the effectiveness of present methods, and areas ripe for improvement in dealing with corrosion... Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N67-13361# Oak Ridge National Lab., Tenn. Isotopes Information Center.
PROCEEDINGS OF INFORMATION MEETING ON IRRADIATED WOOD–PLASTIC MATERIALS HELD AT HILTON HOTEL, CHICAGO, ILLINOIS
Ralph E. Greene and Philip S. Baker, ed. Apr. 1966 136 p refs Meeting held at Chicago, 15 Sep. 1965
(Contract W-7405-ENG-26)
(ORNL-IIC-7) CFSTI: $2.00

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2. BASIC RESEARCH ON IRRADIATED WOOD–PLASTIC COMBINATIONS J. A. Kent (West Virginia Univ.) p 6–14 (See N67-13363 03-18)

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7. RADIATION AND ITS COMMERCIAL FUTURE E. B. Trammel (Atomic Energy Commission) p 49–58 (See N67-13368 03-34)

8. SUMMARY REPORT OF RADIATION PROCESS WOOD–PLASTIC MATERIALS M. H. Stein (Atomic Energy Commission) p 59–63 refs (See N67-13369 03-18)

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10. IRRADIATED WOOD–PLASTIC MATERIALS—COMMERCIAL POSSIBILITIES IN THE PACIFIC NORTHWEST (AND THE GREAT LAKES REGION) C. A. Rohrmann (Battelle-Northwest) p 76–80 ref (See N67-13371 03-18)

11. THE INVESTIGATION OF COMMERCIAL POTENTIAL OF WOOD-PLASTIC COMBINATIONS IN THE NORTHEAST D. M. Egan (State Univ. of New York at Buffalo) p 81–88 (see N67-13372 03-18)

12. COMMERCIAL PRODUCTION OF WOOD-PLASTIC COMBINATIONS L. G. Berrett (American Novswood Corp.) p 89–94 (See N67-13373 03-18)

13. DEVELOPMENT-PRODUCTION PROGRAM FOR LOCKWOOD G. M. Kalember (Lockheed-Georgia Co.) p 95–98 (See N67-13374 03-18)

14. THE OPPORTUNITY FOR COMMERCIAL USE OF IRRADIATED WOOD-PLASTIC MATERIALS IN THE FURNITURE INDUSTRY P. E. Rambaugh (Kroehler Mfg. Co.) p 99–105 (See N67-13375 03-18)

15. POTENTIAL OF WOOD-PLASTIC COMBINATIONS IN THE SPORTING-GOODS INDUSTRY T. R. Harris, Jr. (Hillerich and Bradsby Co.) p 106–111 (See N67-13376 03-18)

16. POTENTIAL COMMERCIAL MANUFACTURE AND USE OF HARDWOOD PLYWOOD PLASTIC COMBINATIONS C. E. Mc Donald (Hardwood Plywood Mfg. Assn.) p 112–118 (See N67-13377 03-18)

N67-13362# Atomic Energy Commission, Washington, D. C. Div. of Isotopes Development.
THE ATOMIC ENERGY COMMISSION'S PROGRAM IN WOOD–PLASTIC MATERIALS

Justin L. Bloom *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. Held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 1–5 (See N67-13361 04-18) CFSTI: $2.00

The four areas that constitute the program are: research on the fundamentals of the process and properties of the materials produced; market surveys and commercialization studies; consolidation of technical and economic information available and preparing conceptual plant design; and cooperative agreements with a representative cross section of wood-products industries to provide consulting services to industry for specific products to be converted to wood–plastic combinations for evaluation purposes. The mission of the Division of Isotopes Development, i.e., expansion of the use of radiation and radioisotopes in applications which are in the national interest, is also briefly described. Author (NSA)

N67-13363# West Virginia Univ., Morgantown.
BASIC RESEARCH ON IRRADIATED WOOD–PLASTIC COMBINATIONS
James A. Kent *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 6–14 (See N67-13361 04-18) CFSTI: $2.00

The basic steps—evacuation, impregnation, and irradiation—for the preparation of samples of wood–plastic combinations (WPC) for physical testing are briefly described. These tests have shown WPC to have general improvements in toughness, bending and compression strength, hardness, moisture resistance, abrasion resistance, shear strength, insect and rot resistance, workability, and other properties. In a comparison of methods to induce polymerization of monomers within wood, irradiation was found to have several advantages over heat: absence of a catalyst within the monomer, which prevents danger of premature polymerization and loss of valuable monomer; enhanced safety of operation; and better control of the rate of polymerization. Author (NSA)

N67-13364# Rohm and Haas Co., Philadelphia, Pa. Special Products Dept.
POLYMERIZATION AND POLYMER PROPERTIES AS RELATED TO WOOD–PLASTIC COMBINATIONS
Richard M. Klein *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 15–21 ref (See N67-13361 04-18) CFSTI: $2.00

The basic mechanism of polymerization of a monomer is briefly described. There are four advantages of using radiation rather than chemical catalysts to induce this polymerization reaction in wood: pot life of the monomer is longer; radiation can overcome effects of resins in the wood that act as inhibitors for chemical catalysts; elevated temperatures and long curing times are not required with irradiation; and no chemical catalyst residue remains in the wood. Three types of polymerization reactions are discussed: graft polymerization between polymer and cellulose; cross-linking of polymers; and copolymers formed from two or more different monomers. The glass transition temperature, a useful parameter for qualitatively estimating mechanical properties of homopolymers and copolymers, together with its application to copolymer systems, is explained. Author (NSA)

N67-13365# North Carolina State Coll., Raleigh. Wood Products Lab.
A TESTING PROGRAM TO INVESTIGATE CERTAIN PHYSICAL AND MECHANICAL PROPERTIES OF SELECTED WOOD-PLASTIC COMBINATIONS
Robert C. Gilmore *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood-Plastic Mater. held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 22–25 (See N67-13361 04-18) CFSTI: $2.00

A testing program to evaluate physical and mechanical properties of wood-plastic combinations (WPC) will be conducted. The objective of the program is to assess the changes in certain physical and mechanical properties of WPC as functions of monomer and monomer loading. Four monomers at four nominal loadings, 0, 33, 66, and 100%, will be used. The program will include static bending, hardness, toughness, abrasion, rate of dimensional change relative to humidity, compression, tension, and vibration tests. Author (NSA)

N67-13366# Lockheed-Georgia Co., Marietta. Nuclear Analysis Dept.
WOOD-PLASTIC EVALUATION PROGRAM
A. O. Burford *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 26–31 (See N67-13361 04-18) CFSTI: $2.00

A program for the wood-products industry to evaluate production samples of radioproduced wood-plastic combinations (WPC) for commercial use is described. Under contract with the USAEC, the Lockheed-Georgia Company will provide impregnation and irradiation services for 78 participating wood-product producers. Evaluation criteria that were used for selection of the 78 of 181 competing companies were based on the product wood species, market potential, dimensions, increased cost, etc. A breakdown of the various types of products and the bases for evaluation of their applicability for commercial use are also included. Author (NSA)

N67-13369# Atomic Energy Commission, Washington, D. C. Div. of Isotopes Development.
RADIATION PROCESSED WOOD–PLASTIC MATERIALS Summary Report
Martin H. Stein *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. Held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 59–63 refs (See N67-13361 04-18) CFSTI: $2.00

The development, properties, and commercial future of wood–plastic products are discussed. Preliminary reports indicate that a production plant with a 3000 lb/hr—8000 hr/year capacity could produce wood–plastic blanks at a reasonable cost. The Atomic Energy Commission's program for development and testing of wood–plastic combinations is also described. NSA

N67-13370# Southern Interstate Nuclear Board, Atlanta, Ga.
POTENTIAL APPLICATIONS OF IRRADIATED WOOD–PLASTIC MATERIALS
Buford B. Ruhl *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. Held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 64–75 (See N67-13361 04-18) CFSTI: $2.00

The objectives of the Southern Interstate Nuclear Board—(SINB) Wood–Plastic Combinations (WPC) project are described. It was concluded that further study of WPC is required before commercialization. Three specific actions were proposed to provide additional data and technology; establishment of an AEC research laboratory for WPC; continued direct support to private industry and universities for development contributions to the WPC process; and invitation for specialized conferences to provide companies with information on how to get into the business of WPC production. NSA

N67-13371# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
IRRADIATED WOOD–PLASTIC MATERIALS—COMMERCIAL POSSIBILITIES IN THE PACIFIC NORTHWEST (AND THE GREAT LAKES REGION)

C. A. Rohrmann *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. Held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 76–80 ref (See N67-13361 04-18) CFSTI: $2.00

An investigation was made of the commercial possibilities of irradiated wood plastics in the Pacific Northwest and Great Lakes regions. Many wood processors were contacted and made aware of properties, production methods, and cost of wood–plastic combinations (WPC). The potential applications of interest include flooring of many types, furniture, veneers, and plywood shapes. The properties of WPC are well suited to these uses and many of the processors showed genuine interest in the new product and its manufacture. As a result of a recent price reduction announced by the USAEC, the use of ^{137}Cs as the radioactive source is suggested for consideration in the design of future WPC irradiation facilities. Author (NSA)

N67-13372# State Univ. of New York at Buffalo.
THE INVESTIGATION OF COMMERCIAL POTENTIAL OF WOOD–PLASTIC COMBINATIONS IN THE NORTHEAST
Douglas M. Egan *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. Held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 81–88 (See N67-13361 04-18) CFSTI: $2.00

In a study of the commercialization of wood–plastic combinations (WPC), the Western New York Nuclear Research Center chose to explore only the requirements for commercialization and excluded studies of market potential and profitability. Identification of products and firms for which WPC seemed to offer promising applications, determination of interest in WPC expressed by firms, and recommendations of promising locations for WPC processing facilities were the major responsibilities of the investigation. Among the more promising applications for WPC considered in the evaluation were flooring, furniture, industrial patterns, and shapings and turnings. Cost considerations and plant siting were also considered in the evaluation. It was concluded that additional information on WPC properties and production is needed before definite results can be obtained. Author (NSA)

N67-13373# American Novawood Corp., Lynchburg, Va.
COMMERCIAL PRODUCTION OF WOOD–PLASTIC COMBINATIONS
Lawrence G. Barrett *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. Held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 89–94 (See N67-13361 04-18) CFSTI: $2.00

The American Novawood Corporation was incorporated in August 1964 and was the first concern to produce wood–plastic combinations (WPC) commercially. In addition to sample preparation, company-sponsored research and development, and supplying materials and consulting services, the company is heavily involved with the construction of a commercial-scale pilot-plant facility. A strong criticism of the continued support of the USAEC development program for wood–plastic combinations is presented: the AEC has adequately demonstrated the value of WPC and should therefore discontinue support and permit private industry to take both the natural business risks and the rewards of their efforts. Author (NSA)

N67-13374# Lockheed-Georgia Co., Marietta. Development Sales Dept.
DEVELOPMENT–PRODUCTION PROGRAM FOR LOCKWOOD
G. M. Kalember *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 95–98 (See N67-13361 04-18) CFSTI: $2.00

Lockheed's development program for their wood–plastic combinations—trade name Lockwood—has included expanded effort on both the process itself and commercial applications. Two problems of expanded commercialization are choosing methods of marketing and defining the types of products and customers for Lockwood. Investigation of thermoplastic monomer systems, impregnation techniques, effects of dose and dose rates on polymerization, physical and engineering properties, and testing and dyeing methods are included in the technical development program. Lockheed now produces 6000 board feet of Lockwood per month on a development-production basis. Author (NSA)

N67-13375# Kroehler Mfg. Co., Louisville, Ky.
THE OPPORTUNITY FOR COMMERCIAL USE OF IRRADIATED WOOD–PLASTIC MATERIALS IN THE FURNITURE INDUSTRY
Paul E. Rumbaugh *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 99–105 (See N67-13361 04-18) CFSTI: $2.00

The Kroehler Manufacturing Company has prepared an occasional-table sample with half of the top of conventionally lacquered oak and the other half of wood–plastic combination. Dealer response to a demonstration of finish resistance to cigarettes and some common household liquids was good. A large sample of hard maple impregnated with dyed methyl methacrylate had little uniformity of color; however, a cocktail table of this material was beautiful, although lighter and more varied in color than several of this firm's Early American styles. The wood worked well with conventional tools and machined cleaner and better than conventional maple. Predrilled holes were required for screws to prevent splitting. The maple WPC glued well with polyvinyl adhesive, moderately well with urea resins, and excellently with fortified urea resins. Early results with WPC veneers were, in general, disappointing but not necessarily pessimistic. The use of WPC for solid-wood furniture may be prohibited by cost except for some specific applications. The greatest possibilities for WPC in furniture appear to be in veneer applications, but further research work is required in their fabrication and finishing techniques. Author (NSA)

N67-13376# Hillerich and Bradsby Co., Louisville, Ky.
POTENTIAL OF WOOD–PLASTIC COMBINATIONS IN THE SPORTING-GOODS INDUSTRY
Thomas R. Harris, Jr. *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 106–111 (See N67-13361 04-18) CFSTI: $2.00

Wood–plastic combinations (WPC) were used to prepare test samples of both baseball bats and golf-club heads. Improved impact strength, moisture resistance, and hardness were observed on these test samples; in addition, golf-club heads had good gluing properties with epoxy adhesives. The increased weight on WPC can easily be compensated for in golf-club heads by using fewer lead weights; however, weight addition is of concern in baseball bats. Durability and appearance of bats are good because the finish literally goes all the way through the wood. With golf-club heads, the use of dyed monomers to eliminate finishing materials and operations would be desirable. Author (NSA)

N67-13377# Hardwood Plywood Manufacturers Association, Arlington, Va.
POTENTIAL COMMERCIAL MANUFACTURE AND USE OF HARDWOOD PLYWOOD PLASTIC COMBINATIONS
Clark E. Mc Donald *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 112–118 (See N67-13361 04-18) CFSTI: $2.00

The market for U. S. hardwood plywood for 1964, exclusive of captive production, was $3.667 \times 10^9 ft^2$ and was valued at $\$441 \times 10^6$. The largest portion of this market was for wall panaling, both prefinished and unfinished, followed by furniture, flush doors, mobile homes, and flooring. For these applications, wood-plastic combinations (WPC) of hardwood plywood would have many advantages—ease of cleaning, ease of repair, better appearance, resistance to staining and marring, etc. Probably the greatest potential for WPC would be for external applications—siding, doors, park benches, etc.—where conventionally treated woods cannot resist weather damage. Author (NSA)

N67-13381# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHETIC FIBERS
26 May 1966 25 p refs Transl. into ENGLISH from Khim. Volokna (Leningrad), no. 3, 1963 p 9–11, 20–24
(FTD-TT-65-1897; TT-66-61958; AD-636673) CFSTI: HC $1.00/MF $0.50

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N67-13382# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING THE PROCESS OF EXTRACTING POLYACRYLONITRILE FIBERS
T. Ya. Grishina, E. A. Pakshver, and V. L. Tsiperman *In its* Syn. Fibers 26 May 1966 p 1–6 refs (See N67-13381 04-18) CFSTI: HC $1.00/MF $0.50

The process of extraction of freshly formed fiber on weaving stand installations was investigated. Fiber was formed from polyacrylonitrile solutions in aqueous dimethylformamide (DMF) baths. The basic polymer had a molecular weight of from 21,000 to 35,000 and was obtained by polymerization with a redox system persulfate-hydrosulfite. Loads developing in the freshly formed fiber at the moment of its extraction were investigated. The plastification role of DMF situated in the fiber during its extraction and the effects of temperature and molecular weight of the polymer on the process of fiber extraction are graphically shown. R.N.A.

N67-13383# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MODIFICATION OF POLYPROPYLENE FIBERS, TISSUES AND TEXTURES BY THE ADOPTION OF ACRYLONITRILE
Z. Manyasek, M. Michko et al *In its* Syn. Fibers 26 May 1966 p 7–19 refs (See N67-13381 04-18) CFSTI: HC $1.00/MF $0.50

An investigation was conducted on the grafting of polyacrylonitrile to preliminary ozonified polypropylene fibers. The process was conducted in acrylonitrile vapors at a temperature of 110°C and with a different content of peroxide groups on the polymer. The grafting rate was proportional to the first stage of peroxide concentrations. The effect of temperature on the grafting rate of polyacrylonitrile to previously ozonated polypropylene fibers was studied. At a temperature of 110°C, the grafting rate was maximum and the activation energy of the grafting process was 10.5 kcal/mol. The grafting process of polyacrylonitrile to propylene fibers in acrylonitrile vapors was investigated during the use of chain transfer reaction from the initiator adsorbed on the fiber surface. The optimum conditions for conducting the grafting process were found. A study of ozonated polypropylene textures in aqueous acrylonitrile solutions in a temperature range of 55° to 100°C showed that during the introduction of Mohr salts into an aqueous phase, the rate of grafting and the amount of homopolymer increases. R.N.A.

N67-13575*# Boeing Co., Seattle, Wash. Space Div.
ANALYTICAL STUDY OF NONMETALLIC PARTS FOR LAUNCH VEHICLES AND SPACECRAFT STRUCTURES
Quarterly Progress Report, Jul. 1–Oct. 1, 1966
1 Oct. 1966 25 p refs
(Contract NAS8-18037)
(NASA-CR-80685; QPR-1) CFSTI: HC $1.00/MF $0.50 CSCL 11I

Fiber reinforced plastics were investigated for use in structural components with particular interest in supporting cryogenic tanks. Three general types of structural elements were selected: compression struts for cryogenic tank supports, pure tension members for cryogenic tank supports, and beams for payload packages. Beams with sandwich web, truss webs, and stiffened webs were considered to determine the least weight approach, and results indicate the sandwich web is the most efficient design over the load range of interest. Details are presented on the buckling tests of round tubes and I-beams. N.E.N.

N67-13897 Polish Academy of Sciences, Warsaw.
THE STRUCTURE OF PYROLYTIC CARBON COATINGS ON URANIUM DICARBIDE PARTICLES
Franciszek Mucha, Zofia Szmid, and Bohdan Kalinowski Aug. 1966 23 p refs
(Rept.-753/IV,II/C) CFSTI: HC $1.00/MF $0.50

X-ray studies on the structure of pyrolytic carbons, deposited on uranium dicarbide particles in the process of a thermal decomposition of methane in a fluidized-bed, have been carried out. The influence of the temperature of pyrolysis in the range 1400°–2150°C, and the concentration of methane in the range 0.05–1.00 1 $CH_4/1$ [CH_4, Ar] has been examined. The structure of pyrolytic carbons depends largely on these parameters. The degree of ordering of the carbon structure increases with the increase in the temperature, and with the decrease in the concentration of methane. Graphite impurities on the surface of uranium dicarbide particles may cause partial crystallization of carbon on graphite seed crystals and may affect the structure of carbon coating. Author

N67-13993# Massachusetts Univ., Amherst. Polymer Research Inst.
SOME STUDIES OF CRYSTAL ORIENTATION IN IRRADIATION POLYETHYLENE Final Report, 1 May 1962–30 Apr. 1966
Richard S. Stein 30 Apr. 1966 11 p refs
(Contract AT(30-1)-3003)
(NYO-3003-29) CFSTI: HC $1.00/MF $0.50

Methods and procedures were developed for the study of the morphology, texture, crystallinity, and kinetics of crystallization of polymers and also radiation cross-linked films. Microscopic observations and light scattering studies demonstrated that the crystals in a polycrystalline polymer are not independent entities but exist in superstructures in which their orientation and location are correlated. Deformation of this structure resulted in orientation of the crystals and a change in the birefringence. The orientation distribution obtained from an x-ray-diffraction-determined pole figure was compared with that predicted theoretically. Unoriented polymers and scattering were also studied. Specific results are given for polyethylene and polypropylene. NSA

N67-14144# Lockheed Missiles and Space Co., Sunnyvale, Calif.
MECHANICAL CHARACTERISTICS OF ORIENTED FIBERGLASS UNDER TENSION
G. V. Bilida [1964] 4 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 10, 1966 p 1280–1282

Several investigations were conducted in order to compare the theoretically computed values for the mechanical characteristics with the experimental results. Formulas are given for determining the theoretical values by the method of elementary addition of the properties of the initial components. Tabulated data are presented on the mechanical characteristics of the initial materials, the experimental and theoretical values of glass plastic characteristics, and the characteristics of glass plastics with epoxyphenol binder and with epoxyphenolfurfurol binder. Analyses show that in a first approximation, in which the rheological properties of the material are not considered, the mechanical characteristics of oriented glass plastics at normal temperature may be determined theoretically.
M.G.J.

N67-14181# Royal Aircraft Establishment, Farnborough (England).
TEMPERATURE LIMITATIONS OF POLYMERIC MATERIALS. PART 3: DIELECTRICS
G. Wood Jun. 1966 40 p refs
(RAE-TR-66203) CFSTI: HC $2.00/MF $0.50

The report reviews the electrical properties of some polymeric dielectrics and indicates the limiting temperatures to which they can be employed with a reasonable retention of their physical and electrical properties.
Author (ESRO)

N67-14190# Royal Aircraft Establishment, Farnborough (England).
AUTOGRAPH: AN AUTOCODE GRAPH PLOTTING SYSTEM
Margaret J. Trigwell Jul. 1966 23 p ref
(RAE-TR-66238) CFSTI: HC $1.00/MF $0.50

Autograph is a program which enables computer programmers to produce a graphical output with the aid of a Benson–Lehner digital incremental plotter. This report contains a full description of the facilities available in the program together with instructions in the use of these facilities.
Author (ESRO)

N67-14207*# Stanford Research Inst., Menlo Park, Calif.
STUDY OF BONDING BETWEEN GLASS AND PLASTIC IN GLASS-REINFORCED PLASTICS, EXTENDED WORK Quarterly Progress Report, Jul. 1–Sep. 30, 1966
David L. Chamberlain, Jr. 28 Dec. 1966 7 p refs
(Contract NASr-49)
(NASA-CR-80836; Rept.-10; QPR-8) CFSTI: HC $1.00/MF $0.50 CSCL 11B

The general objective of this research program is to evaluate the effect of deliberate and known chemical bonding between the glass reinforcement and the plastic matrix of a glass-reinforced plastic composite material. Efforts were made during this period to evaluate the effects of surface modification upon a realistic composite material (such as a filament-wound NOL ring or a woven glass cloth laminate); to study optimum characteristics for surface modifying groups, and improved methods for obtaining them; to study methods for application of surface modification to reinforcement materials other than glass and silica.
Author

N67-14286# Royal Aircraft Establishment, Farnborough (England).
THE EFFECT OF WATER ON THE GELATION OF AN UNSATURATED POLYESTER RESIN
N. C. W. Judd Jun. 1966 12 p refs
(RAE-TR-66191) CFSTI: HC $1.00/MF $0.50

Water retards the gelation and polymerization of an unsaturated polyester resin but to a lesser extent than benzoquinone. On the basis of the data obtained and other information reported in the literature it appears advisable to keep the uptake of water from the environment during a fabrication process to a minimum.
Author (ESRO)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N67-13387# Library of Congress, Washington, D. C. Aerospace Technology Div.
THE PURSUIT PROBLEM AND THE THEORY OF DIFFERENTIAL GAMES
Leonas Kacinskas *In its* Foreign Sci. Bull., vol. 2, no. 10 Oct. 1966 p 1–5 refs (See N67-13386 04-34)

The pursuit of one controlled object by another controlled object is considered as the initial problem. To simplify calculations, the pursuit problem is generalized and converted to a problem of the theory of differential games. An approach to the solution of this problem is presented. By applying constructions similar to those used in establishing the maximum principle, a method is described for deriving the complete system of ordinary differential equations and its solution resulting in the construction of a differentiable function w(s) which maps a certain manifold S into the phase space of the problem.
Author

N67-13533*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME NONPARAMETRIC TESTS FOR RANDOMNESS IN SEQUENCES
Peter D. Argentiero and Robert H. Tolson Washington, NASA, Dec. 1966 21 p refs
(NASA-TN-D-3766) CFSTI: HC $1.00/MF $0.50 CSCL 12A

A rigorous definition of the concept of a random sequence is stated and statistical tests of the hypothesis that a given data sequence is random are discussed and tables are provided to facilitate the use of these tests. Certain tests are recommended for the detection of periodic nonrandomness and others are recommended for the detection of nonperiodic nonrandomness. A battery of tests designed specifically for the detection of periodic nonrandomness is constructed and examples of its use are given. The same is done for a battery of tests designed for the detection of nonperiodic nonrandomness. The question of the relationship between the confidence coefficient of a battery of tests and the confidence coefficients of the individual tests of the battery is considered.
Author

N67-13537*# Consultants and Designers, Inc., Arlington, Va.
ON THE APPLICATION OF DIFFERENCE METHODS FOR THE ASYMPTOTIC ESTIMATES OF ERRORS AT NUMERICAL INTEGRATION OF SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS [ASIMPTOTICHESKIYE OTSENKI POGRESHNOSTEY PRI CHISLENNOM INTEGRIROVANII SISTEM OBYKNOVENNYKH DIFFERENTSIAL'NYKH URAVNENIY RAZNOSVNYMI METODAMI]
M. L. Brodskiy 24 May 1966 7 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 43, no. 4, 1953 p 599–602
(Contract NAS5-9299)
(NASA-CR-80650; ST-MAT-10491) CFSTI: HC $1.00/MF $0.50 CSCL 12A

The demonstration is based upon a lemma, a theorem, and the ensuing corollary. Three particular cases are considered–the

Adams, Milne, and the Simpson methods. The final formula was tested on a few examples showing good agreement with the computation after introducing an artificial error. Author

N67-13576*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
ON THE OPTIMIZATION OF MIXTURE RESOLVING SIGNAL PROCESSING STRUCTURES
J. C. Hancock and W. D. Gregg Oct. 1966 99 p refs
(Grants NsG-553; NSF GP-2898)
(NASA-CR-80684; TR-EE66-11) CFSTI: HC $3.00/MF $0.75 CSCL 12B

The structural form of optimum linear detection operators with unknown classification parameters, and the mixture resolving estimators are developed. The unknown pulse waveform and noise parameters are obtained by mixture resolving estimation. The observation signal model consists of a discrete, multidimensional, binary gaussian mixture. The mixture resolving categories consist of an optimized, time varying weighted decision directed category, and a moment method category. It was considered that there is a significant improvement over the conventional decision directed algorithm by processing with a formally developed weighting iteration without the computational complexity of the formal Bayes mixture requirement. N.E.N.

N67-13609*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
STUDY ON DETERMINING STABILITY DOMAINS FOR NONLINEAR DYNAMICAL SYSTEMS, II Quarterly Progress Report, 1 Aug.–31 Oct. 1966
J. V. Abbate, G. R. Geiss, and R. Mc Gill 15 Nov. 1966 22 p refs
(Contract NAS8-20306)
(NASA-CR-80713; RM-348; QPR-2) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Particular items discussed are: experimental results obtained via the algorithm developed during the previous quarter; reformulation of the algorithm to avoid computational difficulties encountered during the experiments; development of a parameterization of the set of positive definite nXn matrices; and analysis of a system with time dependent closed loop guidance. Plans for research during the last phase of the contract are outlined. Author

N67-13645# Portugal. Nuclear Energy Commission, Sacvêm. Div. of Physics.
ON THE NOTION OF LIMIT OF A DISTRIBUTION TO THE INFINITE [SOBRE A NOCAO DE LIMITE DE UMA DISTRIBUICAO NO INFINITO]
Jaime Campos Ferreira 1965 18 p refs In PORTUGUESE
(LFEN.43(α.δ)) CFSTI: HC $1.00/MF $0.50

Mathematical expressions are reviewed on the concept of the boundary of distribution f(x) when x leads to infinity. Some selected definitions of this distribution are presented, and a generalization is made of the usual boundary concept of a function whose essential properties are retained. This definition is extended to include the integral of distribution f on R. Consideration is given to some of its elementary properties of the boundary. Transl. by R.U.

N67-13704# Lockheed Missiles and Space Co., Palo Alto, Calif.
EXISTENCE OF THE SOLUTION OF A BOUNDARY VALUE PROBLEM FOR AN n-th ORDER NONLINEAR DIFFERENTIAL EQUATION
A. Ia. Lepin and A. D. Myshkin [1966] 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 169, no. 1, 1966 p 16–19

Theorems are proposed and a generalization of the fundamental problem is given for a solution to the boundary value for *nth* order nonlinear differential equations. All of the quantities used are in the proofs that are real and finite; and these proofs make use of the Kolmogorov–Horn inequality, various congruency relationships, and a continuation of the Cauchy problem. M.W.R.

N67-13863# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON A VARIATIONAL PROBLEM IN HILBERT SPACE AND ITS APPLICATION TO PARTIAL DIFFERENTIAL EQUATIONS
Z. I. Khalilov and E. Dzh. Aslanov [1966] 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 169, no. 5, 1966 p 1020–1023

The problem is formulated by considering real Hilbert spaces, H_1 and H_2, with scalar products and a linear continuous operator acting from H_1 into H_2. Constructions are presented and applied to the solution of a generalized Couchy problem. Written in this form it is shown that the solution of variational problems may be applied to the investigation of analogous questions for partial differential equations. As an application, consideration is given to the Couchy problem for a heat conduction equation. C.T.C.

N67-13915# Naval Radiological Defense Lab., San Francisco, Calif.
THE SOLUTION OF THE LIOUVILLE EQUATION IN THE INFINITE LIMIT
Boris Leaf and William C. Schieve 6 Sep. 1966 21 p refs
(USNRDL-TR-1066; AD-639749)

Methods have been developed for performing the Cauchy integral identified in a previous paper. The singularities in the complex plane of this integral determine the time dependence of the solutions of the Liouville equation in the infinite limit for systems describable in angle-action variables. The singularities do not have the form assumed previously in analogy with the work of Prigogine's group. Solutions in the infinite limit have the same form as for finite systems. Taking the infinite limit, with continuous spectrum of the Liouville operator, is equivalent to expressing the solution to the Liouville equation as a Fourier integral in the angle variables instead of a Fourier series as for a finite system with periodic boundary conditions. The solution in this case is no longer multiply periodic in time. The phase space on which ensemble averages are computed must be extended from the range zero to one for the angle variables for finite systems to the range of the entire real axis for systems in the infinite limit. The Liouville operator is Hermitian on this space. For systems for which angle-action variables exist, the solutions of the Liouville equation cannot become time-independent even in the infinite limit. Author (TAB)

N67-13918# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
SOME ASPECTS OF SELECTION AND RANKING PROCEDURES WITH APPLICATIONS
Shanti S. Gupta and William J. Studden Jul. 1966 17 p refs
Its Mimeograph Series No. 81
(Contract Nonr-1100(26); AF 33(657)-11737)
(AD-639719) CFSTI: HC $1.00/MF $0.50

The purpose of the paper is to discuss the problems of ranking and selection in a more or less unified form and suggest some applications to problems in reliability. More specifically, the authors discuss the problem of selecting a sub-set of k populations or processes which in some sense is a best subset. TAB

N67-14008# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
A MATHEMATICAL FOUNDATION FOR EMPIRICAL SCIENCE, WITH SPECIAL REFERENCE TO QUANTUM THEORY. PART I: A CALCULUS OF EXPERIMENTAL PROPOSITIONS

C. H. Randall (Ph.D. Thesis–Rensselaer Polytech. Inst.) Jun. 1966 223 p refs
(Contract W-31-109-ENG-52)
(KAPL-3147) CFSTI: HC$6.00/MF$1.25

The aim of an empirical science is to order, explain and predict the observable events associated with certain physical situations or experiments. As such its mathematical foundations ought to be erected on a formal language capable of describing these physical occurrences with adequate precision. The direct approach is to synthesize a formal symbolic logic from the real physical operations employed in an empirical science. In this regard formal symbolic logic is a collection of propositions partly ordered by some implication relation. The operational point of view has the virtue of providing such a logic without first committing itself to some model of reality. The calculus of experimental propositions is investigated. Topics discussed are historical review; experiments (events and operation); lattice of events (objective implication and simultaneous observability); conditioning (temporal order); operational, perspective, and translational equivalence; free operational logic; and sublogics. NSA

N67-14041# Oak Ridge National Lab., Tenn.
DATA ON A SET OF TRINOMIAL DISTRIBUTIONS
V. R. Rao Uppuluri and Kimiko O. Bowman Sep. 1966 86 p refs
(Contract W-7405-ENG-26)
(ORNL-4004) CFSTI: HC$3.00/MF$0.75

A Fortran IV program is briefly described which can be used to study any trinomial distribution exactly, for sample sizes ranging from 5 to 75. In the case of a set of eleven trinomial probability vectors which have arisen naturally in connection with a multi-judge reliability problem (which seem to be a representative set), tables are given for n = 10, 15 and 20 which contain information on the exact trinomial probabilities associated with each partition of n, and the distribution of the likelihood ratio test criterion and the distribution of Pearson's X^2 statistic. NSA

N67-14047# Sandia Corp., Albuquerque, N. Mex.
TABLES OF ψ-FUNCTIONS
W. P. Ronold and Charles W. Harrison, Jr. Apr. 1966 24 p ref
(Contract AT(29-1)-789)
(SC-R-66-896) CFSTI: HC$1.00/MF$0.50

Certain integrals useful in the approximate solution of the integral equation for the current in a cylindrical antenna are evaluated and represented graphically and in tabular form. Author (NSA)

N67-14102*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ON THE STABILITY OF NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS
Robert N. Lea Washington, NASA, Jan. 1967 11 p refs
(NASA-TN-D-3760) CFSTI: HC$1.00/MF$0.50 CSCL 12A

A method for determining a region of relative stability for a class of interpolation and extrapolation formulas is obtained. Although the method is primarily concerned with the problem of relative stability for integrating systems of ordinary differential equations, some considerations are also given to the absolute stability of this class of formulas. Certain parameters were restricted to insure that the numerical solution is stable. K.W.

N67-14143# Lockheed Missiles and Space Co., Sunnyvale, Calif.
GEOMETRIC THEORY OF UNITARY EQUIVALENCE OF MATRICES
L. A. Kaluzhnin and Kh. Khavidi [1966] 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 169, no. 6, 1966 p 1009–1012

The question of unitary equivalence of matrices is treated in the terminology of n-dimensional unitary geometry. A procedure is given for a sequential evaluation of the numerical invariants for α and β, whose coincidence is necessary and sufficient for their unitary equivalence. The geometric treatment is considered to permit generalization. Author

N67-14196# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
THE GLOBAL METHOD: PRINCIPLE AND APPLICATION TO VIBRATION PROBLEMS [DAS GLOBALE VERFAHREN: PRINZIP UND ANWENDUNG AUF SCHWINGUNSPROBLEME]
Gerhard de Vries 1966 32 p refs In GERMAN and FRENCH Presented at the Meeting of Ger. Engr. Soc. on Tech. of Vibrations, Augsburg, 3–4 Oct. 1966 Submitted for Publication
(TP-405) CFSTI: HC$2.00/MF$0.50

In this paper the aim of global vibration tests and the present trends in experimental methods are presented. The utilization of the results and the limitations of the methods are discussed. Author (ESRO)

N67-14197# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
THRUST-LIFT INTEGRATION AND ITS CONSEQUENCES ON THE ECONOMY OF ATMOSPHERIC FLIGHT AT HIGH SPEED [LA SYNTHESE SUSTENTATION-PROPULSION ET SES CONSEQUENCES SUR L'ECONOMIE DU VOL ATMOSPHERIQUE A GRANDE VITESSE]
Pierre Contensou [1966] 36 p In FRENCH; ENGLISH summary Presented at the 5th I.C.A.S. Congr., London, 12–16 Sep. 1966 Submitted for Publication
(TP-366) CFSTI: HC$2.00/MF$0.50

This paper which is devoted to the air-breathing aircraft, presents a simplified analysis of the possibilities offered by a single air flow accelerated and deviated for both propulsion and lift. This type of aircraft in a flight speed range between 3000 and 4000 m/sec presents advantages over the usual lifting-surface with conventional power plant. The second part is a short survey of possible long-range flight paths making use of that system, and such that the mass consumption and the flight duration are optimized; their overall performance is also examined. Author (ESRO)

N67-14198# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
ANALYTICAL STUDY OF SPIN [ETUDE ANALYTIQUE DE LA VRILLE]
Michel Scherer and Marie-Odile Aguesse [1966] 35 p refs In FRENCH; ENGLISH summary Presented at the AGARD Meeting on Stability and Control, Cambridge, Great Britain, 20–23 Sep. 1966 Submitted for Publication Prepared jointly with Fluid Mech. Inst.
(TP-388) CFSTI: HC$2.00/MF$0.50

A method of spin calculation has been studied; and the aerodynamic parameters used in the calculation were obtained by analytical wind-tunnel measurements of the constant and variable derivatives, performed on the same model, and serve as an aerodynamic basis in the calculation of the aircraft motion through a program of automatic numerical computation. The aim of these first calculations was to corroborate the free flight results obtained in the vertical wind tunnel on a model of the delta 60 aircraft. The results thus obtained are analyzed and discussed. Author (ESRO)

N67-14202*# Tennessee Univ., Knoxville.
REMARKS ON A PAPER OF LEIGHTON
John S. Bradley and John T. Varner, III [1965] 13 p ref
(Grant NGR-43-001-029)
(NASA-CR-80841) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Counterexamples are presented to theorems which were used to obtain some conditions for a solution to a differential system $y'' + py = 0$, $y(a) = 0$ to have a zero in an interval (a,b). An attempt is made to show how the hypotheses of these theorems may be strengthened so that the conclusions are valid. In particular, the requirement that the coefficient function p be of class C' and convex, or concave in one theorem, is replaced by the conditions that p be continuous and satisfy a certain integral inequality.
M.G.J.

N67-14242# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
ON CONFIDENCE LIMITS FOR THE RELIABILITY OF SYSTEMS
Janet Myhre (Claremont Men's Coll.) and Sam C. Saunders Nov. 1965 40 p refs *Its* Mathematical Note 435
(D1-82-0489; AD-627305) CFSTI: HC $2.00/MF $0.50

An application of the asymptotic Chi-square distribution of the log-likelihood ratio is made to obtain approximate confidence intervals (or interval estimates) for the reliability of any structure of the class of structures which can be represented by a monotone Boolean function of Bernoulli variates. This is for the case when the data available consist of a number of Bernoulli trials for the performance or non-performance of the components. Some special methods are obtained for a subclass of structures which contain those which fail if, and only if, a certain prescribed number of their components fail. This generalizes the results of A. Madansky for series, parallel and series-parallel systems. Computational procedures are given and some numerical studies are reported which assess how accurate the confidence intervals are as a function of the sample size. Some comparisons are made with exact results in the cases where they are known.
Author (TAB)

N67-14334# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
A NOTE ON NON-LINEAR APPROXIMATION THEORY
A. A. Goldstein (Wash. Univ., Seattle) Sep. 1966 11 p refs Sponsored in part by AFOSR *Its* Math. Note No. 482
(DI-82-0565; AD-640441) CFSTI: HC $1.00/MF $0.50

Recently J. R. Rice (Approximation of Functions, Elsevier Pub. Co. 1965, p. 111-133) initiated a geometrical study of non-linear approximations. This paper offers a small contribution to certain analytical aspects of mean-square non-linear approximations. One result is to exhibit a family of non-linear topological subspaces of the space C (a,b) with the mean-square metric which has a local unique best approximation property.
Author (TAB)

N67-14335# California Univ., Berkeley. Operations Research Center.
ON A GROUP THEORETIC APPROACH TO LINEAR INTEGER PROGRAMMING
William W. White Sep. 1966 104 p refs
(Contract DA-31-124-ARO(D)-331)
(ORC-66-27; AROD-5307-17; AD-640175) CFSTI: HC $4.00/MF $0.75

The paper extends some results of Gomory on a group theoretic approach to linear integer programming. An algorithm for solving integer programming problems is presented, and the relation of this work to cuts and appropriate geometric interpretations is given. The theoretical basis for the algorithm establishes a characterization of integer solutions to linear programs by considering the Gomory column group associated with the optimal linear programming basis. It is shown that if an optimal integer solution exists, it can be obtained by finding the rth optimal solution to an optimization problem over elements in this Gomory group, for some finite *r*. A dynamic programming procedure for finding this rth optimal solution is given, and shown to be equivalent to finding an rth shortest route through a specially constructed network. A particular class of cutting planes is discussed. These cuts are shown to be parallel to a subset of Gomory cuts and at least as strong as the Gomory cuts. Specially structured integer programs are discussed with a view toward speeding computation. Included in this discussion is a specialization to zero-one variables. Some computational results are given. It is seen that computational efficiency depends crucially on the size of the absolute value of the determinant of the optimal linear programming basis. In general, the smaller this absolute value, the more efficient the algorithm.
Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N67-13487# North American Aviation, Inc., Columbus, Ohio.
MICROWAVE RADIOMETRIC METEOROLOGICAL OBSERVATIONS
Charles A. Cummings and J. W. Hull *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 263-271 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Described are the radiometer, the antenna system, and techniques used in collecting and analyzing the meteorological data. Data were collected in the 35 and 23-GHz regions of the frequency spectrum. Observations in the 23-GHz region were made at the center of the water vapor absorption band, resulting in a high degree of resolution of changes in cloud mass, fog, and rain. A simple twin-horn antenna technique was used, with one antenna oriented vertically and the other oriented 45° from the vertical. The input to the radiometer was alternately switched between the two antennas, with a 2-minute exposure for each antenna. The radiometer sensed direction of cloud mass movement and was capable of discerning between and measuring degrees of cloudiness, rain, and fog.
K.W.

N67-13490# Wisconsin Univ., Madison. Dept. of Meteorology.
DOUBLE BOLOMETER MEASUREMENTS OF THE EFFECTS OF ATMOSPHERIC RADIATORS
P. M. Kuhn (Environ. Sci. Serv. Admin., Madison, Wis.), R. A. Ragotzkie, and V. K. Mennon *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 293-304 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The feasibility of an airborne, double bolometer (radiometer) technique for deriving atmospheric water vapor profiles at modest cost is illustrated. To achieve these results with "shelf" equipment, the radiative transfer equations are solved for the water vapor transmissivity at aircraft holding levels using observed upward irradiances as input data. The transfer solutions are obtained from computer programs developed specifically for this purpose. Results indicate an accuracy at least as good as that of the standard sounding electrical hygrometer but with measurements obtained at levels much higher than those at which hygrometer observations are possible. The implications for use on high-flying jet or special purpose aircraft or on rockets are presented.
Author

N67-13498# Aracon Geophysics Co., Concord, Mass.
SOME PROBLEMS IN USING TIROS RADIATION DATA AS FILED ON FINAL METEOROLOGICAL RADIATION TAPES

Paul E. Sherr *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 433-446 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Error detection and correction in using Tiros infrared radiation data at a synoptic or smaller scale are discussed. Considered are such problems as exact geographic data location and data resolution errors. Also covered is the avoidance of problems on future remote sensing systems, especially of the earth-scanning variety. Examples of the meteorological content of such data are presented. K.W.

N67-13562# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

ON THE ROLE OF THE MANNED SATELLITE FOR METEOROLOGY

P. E. Wasko, E. V. Petersen, and V. Sirounian Sep. 1966 59 p refs

(DAC-59300)

The four major roles discussed are: (1) the development of instrumentation and techniques for future manned or unmanned meteorological satellites; (2) the testing and assessment of the applicability of spacecraft meteorological instrumentation and techniques to operational needs; (3) the conducting of atmospheric research needed to promote the development of improved capabilities in weather prediction and modification; and (4) the development, testing, and assessment of the role of an astronaut-meteorologist in reliable weather reconnaissance, prediction, modification, and research. The observational methods for the meteorological spacecraft are discussed with respect to (1) the observational requirements, (2) the observational techniques and instrumentation, and (3) the physical characteristics of the instruments. Finally, the role of the meteorologist aboard the orbital spacecraft is portrayed. Author

N67-13611# Miami Univ., Coral Gables, Fla. Inst. of Marine Science.

RADAR HURRICANE RESEARCH Final Report, 1 Sep. 1965-31 Aug. 1966

Harry V. Senn Sep. 1966 53 p refs

(Contract Cwb-11266)

(ML-66299)

Radar operations and observations of hurricanes during the 1965-66 fiscal year are summarized. Simultaneous PPI and RHI radarscope film were obtained in both hurricane Betsy 1965 and hurricane Alma 1966. A study is presented utilizing reconnaissance film to determine over-water hurricane precipitation patterns which might serve as indicators of the direction of storm center motion. With certain significant modifications, the results are similar to the patterns viewed from land based radars as storms approach. The three-dimensional distribution of precipitation in hurricane Betsy 1965 is presented and compared to that obtained during Cleo 1964. The vertical shear vector is negative and very large in the lowest 6,000 ft when Betsy was undergoing rapid intensification north of Puerto Rico. When the hurricane was more intense and in the Florida Keys area the shear vector was less negative in most spiral band areas, but was turned strongly outward across the bands near the center of the storm. The bright band was found in almost all parts of the storm with precipitation heights appreciably exceeding the melting level, especially in and around the eye wall and inner spiral band regions where it was considerably higher than in the outer precipitation areas. Author

N67-13702# Joint Publications Research Service, Washington, D. C.

EXPERIMENT ON THE INVESTIGATION OF CLOUD COVER AND OUTGOING RADIATION WITH THE SATELLITE "KOSMOS-112"

I. P. Vetlov 30 Dec. 1966 14 p Transl. into ENGLISH from Russian Presented at World Meteorol. Organ. Sem. on the Interpretation and Use of Meteorol. Satellite Data, Moscow, Oct. 1966

(JPRS-39188; TT-66-35610) CFSTI: $1.00

Information obtained from the Kosmos 112 satellite demonstrates the importance of simultaneously obtained TV and IR cloud cover images of outgoing radiation in the analysis of weather conditions and atmospheric processes. The apparatus used is described in detail, as are the recording and conversion of the data obtained. Photographs indicate cloud eddies corresponding to cyclones, hurricanes, and typhoons; broad bands of clouds corresponding to atmospheric fronts and zones of intratropical convergence; and fields of intramass clouds. Mesoscale features of large-scale cloud systems seen include transverse bands of clouds, usually arranged perpendicular to the air stream; orographic cloud bands on the leeward side of mountains that repeat the basic bands of the mountain ranges; and cumulus and stratocumulus convective clouds. Within the large-scale cloud systems on the IR photographs can be seen mesoscale features with dimensions on the order of 100 km. Practically no difference in contrast is noted between day and night IR images. M.W.R.

N67-13900# Canada. Dept. of Transport, Toronto.

ANNUAL AND SEASONAL TEMPERATURE AND PRECIPITATION TRENDS IN BRITISH COLUMBIA SINCE 1890

J. M. Powell 15 Sep. 1965 74 p refs

(CIR-4296; CLI-34) CFSTI: HC $3.00/MF $0.75

The annual and seasonal trends and fluctuations of temperature and precipitation for a number of stations and regions in British Columbia are discussed as part of a project to investigate the relation between climate and population trends of the bark beetle, Dendroctonus ponderosae Hopkins. All available records of 107 weather stations were examined for 5-yr fluctuations and 30-yr trends, which are illustrated by tables and graphs. Five-year running means indicated a tendency for warm and dry periods, or wet and cool periods to occur together. Some evidence from dendrochronology, river runoff rates, glacial activity, and changes in floral distribution associated with climatic change is also discussed. L.E.W.

N67-13905*# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex. Meteorological Working Group.

DATA REPORT OF THE METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME LIV: FEBRUARY 1966 FIRINGS

Aug. 1966 230 p

(NASA-CR-80854; DOC.-109-62) CFSTI: HC $6.00/MF $1.25 CSCL 04B

February 1966 firings of the Meteorological Rocket Network are summarized in tables and graphs. Sounding data are included for chaff, chute, and sphere wind sensors for the following types of rockets: Arcas, gun probe, Hasp II and III, Judi, Loki, Loki Dart, and Sirocco. Data were collected at White Sands Missile Range and reduced at Texas Western College. Printouts of the reduced data include rocket winds, thermodynamics, and/or radiosonde observations for the various days when recordings were made. M.W.R.

N67-14154# Joint Publications Research Service, Washington, D. C.

PROBLEMS IN AVIATION METEOROLOGY

V. A. Shtal' 12 Dec. 1966 43 p Transl. into ENGLISH from the publ. "Problemy Aviatsionnoy Meteorologii" Leningrad, Gidrometeorol. Id., 1966 p 59-96

(JPRS-39053; TT-66-35476) CFSTI: $2.00

The exchange of meteorological information between countries and continents is discussed in relation to the need for improved apparatus and faster dissemination of data. The various services which have been organized to handle the problem are reviewed, along with the Soviet Union–United States agreement for exchanging meteorological data. The exchange of these data between the ground and an aircraft is also considered, and the difficulties involved in transmitting weather data from scheduled aircraft to meteorological centers are assessed. The possibility of onboard automatic recording is suggested, and the advantages of direct communication between the pilot and the weatherman are pointed out. The basic problems involved in organizing supersonic transportation are also reviewed, with attention focused on the meteorological services which will be required. Consideration is given to spatial and temporal distribution of stratospheric winds and temperatures; and the influence of air temperature, wind, cloud cover, visibility, and precipitation. M.G.J.

N67-14231*# Israel Program for Scientific Translations, Ltd., Jerusalem.
METEOROLOGICAL STUDY IN MOUNTAINOUS REGIONS OF THE USSR SHOULD BE CONTINUED
G. P. Dubinskii *In its* Geophys. Bull., No. 13 1966 p 72–73 ref (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

On the basis of meteorological observations in the mountains of the Caucasus which were conducted for the International Geophysical Year, it is proposed that these studies be continued and the existing network of observation points be enlarged with observations conducted the whole year round. Suggested is the establishment of a single control center for mountain meteorology in the Geographical Institute of the Academy of Sciences of the USSR so that systematic meteorologically study in mountain regions can be undertaken. S.C.W.

N67-14262# Royal Aircraft Establishment, Farnborough (England).
PROJECT TOPCAT: SUMMARY OF THE METEOROLOGICAL OBSERVATIONS AND AIRCRAFT MEASUREMENTS DURING ROUTINE FLIGHT IN THE AUSTRALIAN JET STREAM
E. W. Wells Apr. 1966 129 p refs
(RAE-TR-66122) CFSTI: HC $4.00/MF $1.00

A number of flights have been made over set tracks and heights to measure clear air turbulence in the vicinity of the Flinders Ranges in South Australia. Details of the meteorological observations and flight paths, and measurements of wind, temperature, and turbulence obtained from the aircraft instrumentation are presented. Wind and temperature gradients have been derived for cross sections on the upwind and downwind sides of the ranges and a comparison made of the intensity of turbulence between the two sides. Author (ESRO)

N67-14318# Atmospheric Research and Development Corp. Kansas City, Mo.
ESTIMATING THUNDER STORM PENETRATIONS OF THE TROPOPAUSE
Michael J. Long Jul. 1966 32 p refs
(Contract AF 19(628)-5189)
(AFCRL-66-556; SR-1; AD-640282) CFSTI: HC $2.00/MF $0.50

Data sources for radar measurements of thunderstorm penetrations of the tropopause level outside the United States are listed, but large areas will not be covered in any event. Two studies suggest that the sole use of low level moisture or the maximum amount of energy available to a storm as determined from a sounding will not be successful in estimating the distribution of penetrations above the tropopause level. An equation of the form $Y = Ae^{-Bx}$ was found to fit the cumulative distribution of penetrations of the tropopause level to a high degree at all the stations studied. A method of estimating the cumulative frequency of penetrations based on a determination of the highest penetration likely to occur and the equation mentioned above gave good results for two widely separated stations in the United States having different thunderstorm climatologies. Author (TAB)

N67-14332# Texas A&M Univ., College Station. Dept. of Oceanography.
OBJECTIVE DEFINITION OF THE THERMOCLINE
N. E. J. Boston Aug. 1966 52 p refs
(Contract Nonr-2119(4))
(Rept.-66-19T; AD-640410) CFSTI: HC $3.00/MF $0.50

An objective method of analyzing bathythermograph data is discussed. A simple analysis of finite differences provides objective definition of the top, bottom and center of the thermocline. Secondary features such as transients, multiple thermoclines and inversions are examined in the light of this method and objectively analyzed with some success. A general program for the efficient handling of bathythermograph data is suggested and computer flow diagrams given. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N67-13934 Decca Radar Ltd., Isle of Wright (England).
AIRBORNE DOPPLER NAVIGATION TECHNIQUES, CHAPTER 13
Trevor Gray *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 217–234 refs (See N67-13921 04-07)

Information on the techniques which have been known for some time is collated, and the advantages and disadvantages of each technique are indicated. A brief description is given of the possible system configurations and of the various transmission techniques available to the designer. The methods of computing the information provided by the basic Doppler system are discussed, and the effects of recently developed components and techniques on Doppler design are indicated. C.T.C.

N67-13935 Cutler-Hammer, Inc., Dee Park, N. Y. Airborne Instruments Lab.
SCANNING BEAM GUIDANCE FOR APPROACH AND LANDING, CHAPTER 14
J. E. Woodward *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 235–252 (See N67-13921 04-07)

An account is given of a radio guidance system for aircraft which is a combination of the usual ILS and a precision approach radar. Two ground stations are used in order to give control in azimuth and glide angle. These are sited one at each end of the runway. A similar system could be applied to landings on aircraft carriers. Author

N67-13938 Royal Radar Establishment, Malvern (England).
AN AUTOMATIC F.M.C.W. SURVEILLANCE RADAR, CHAPTER 15
C. S. E. Phillips *In* AGARD Radar Tech. for Detection Tracking and Navigation 1966 p 253–265 refs (See N67-13921 04-07)

The paper describes a proposed fully automatic radar system which can detect and track targets both at low level and, at higher elevation angles, at ranges out to some 150 km. A high data rate is obtained by rotating the aerial system at about one

revolution per second. The elevation beam can be switched into any one of twenty three positions under the control of a digital computer. Progressive variations in modulation frequency enable unambiguous though inaccurate range to be obtained after two paints and for the range error to be halved after each succeeding paint. Targets can be tracked through zero radial velocity with the help of further waveform changes. The computer has the dual role of (1) associating azimuth angle, elevation angle, Doppler frequency and range measurements so as to form tracks, and (2) controlling the aerial system, the transmitted waveform; the radar receiver and the auto-extraction equipment so as to provide the data in the most efficient manner. Author

N67-13959# Royal Aircraft Establishment, Farnborough (England).
THE LONG PERIOD ERRORS OF DOPPLER AND INERTIAL NAVIGATION SYSTEMS
S. G. Smith and I. L. Thomas Mar. 1966 26 p
(RAE-TR-66084)

Dead reckoning navigation systems making use of gyros have to take account of the earth's rotation and the vehicle's motion round the earth since these rotations will be sensed by the gyros. In general the gyro correction terms are functions of latitude; and, therefore, the system generates a feedback loop within itself since the final output (latitude) is used to correct the mechanism which is producing this output. The sense of this feedback in most cases is such that the errors are oscillatory rather than divergent. The period of oscillation is 24 hours for a stationary I.N. system; but, in general, this is modified by the E–W component of this velocity. The effects are shown to have little significance in Doppler systems but are helpful in some cases of long flights (>4 hours) with inertial systems. Author

N67-14119# Royal Aircraft Establishment, Farnborough, (England).
SPECIFYING THE CALIBRATION OF STATIC PRESSURE SYSTEMS FOR THE SAFE USE OF 1000 ft VERTICAL SEPARATION STANDARD IN NORTH ATLANTIC JET TRAFFIC
P. G. Reich and R. G. Anderson May 1966 57 p refs
(RAE-TR-66156) CFSTI: HC $3.00/MF $0.50

The collision risk associated with the use of a 1000 ft separation standard for North Atlantic jet traffic in the period 1966–71 is related to the quality of aircraft height-keeping. By allowing for those component errors of height-keeping that have already been measured, safety from collision is related directly to measures of the quality with which the altimeter static pressure system is calibrated and maintained. Suggestions are made for the form of the initial calibration and for checks to guard against the effects of subsequent damage which may invalidate it. Evidence is offered on the durability of a calibration, and hence on the frequency of checking that is consistent with a given level of safety from collision. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N67-13360# Bettis Atomic Power Lab., Pittsburgh, Pa.
CYGRO-1 STRESS ANALYSIS OF THE GROWTH OF CONCENTRIC CYLINDERS
C. M. Friedrich Jul. 1966 18 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-514, Addend. 1) CFSTI: HC $1.00/MF $0.50

The digital computer program CYGRO-1 determines stresses and strains in two concentric cylinders undergoing thermal strains and irradiation growth where elastic, plastic, and creep properties are given as functions of temperature, fissioning rate, and integrated flux. In addition to the analysis presented in WAPD-TM-514, the computer program includes fuel sintering and hot-pressing and has provision for including an incompressible center plug. Author (NSA)

N67-13390# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
ENGINEERING AND METALLURGICAL EVALUATION OF AN IRRADIATED YANKEE CORE I CONTROL ROD
W. R. Smalley and E. Paxson Jul. 1966 58 p refs
(Contract AT(30-1)-3017)
(WCAP-6074) CFSTI: HC $3.00/MF $0.50

Ni–plated Ag–In–Cd control rods from Yankee Core I were examined to determine the effects of reactor exposure on their irradiation stability. The samples were evaluated for changes in surface condition, dimensions, microstructure, and tensile properties. Visual and metallographic examination revealed that large areas of the control rods absorbers were devoid of Ni plate and that the remaining plating had been attacked by the reactor coolant. The metallographic evaluation further indicated that the Ni plate and associated diffusion layer were not effective in preventing internal oxidation of the base metal. The Ag–In–Cd alloy itself displayed good dimensional and irradiation stability during reactor operation. The microstructure of the alloy was essentially unchanged, with no evidence of new phases or significant precipitation. Similarly, the hardness and tensile properties of irradiated absorber samples showed no appreciable changes as a result of exposure in Yankee Core I. Author (NSA)

N67-13440# European Atomic Energy Community, Brussels (Belgium).
GUNDREMMINGEN (KRB) NUCLEAR POWER PLANT Annual Report, 1965 [KERNKRAFTWERK GUNDREMMINGEN (KRB)—JAHRESBERICHT 1965]
Sep. 1966 54 p In GERMAN
(EURATOM-005-63-4-REPD)
(EUR-3067.D) CFSTI: HC $3.00/MF $0.50

During 1965 construction of the Gundremmingen nuclear power plant was largly completed, the concrete shell fitted around the reactor containment and the internal finishing work virtually terminated. The first trial run of the turboset revealed no defects. In order to prepare the operating permit, the licensing authorities and the Technical Inspection Authority were kept constantly informed about the design of the plant. All the documents required for the safety assessment were forwarded. The licensing procedure with regard to the water supply laws has now been completed. The permit for the transportation and storage of the fuel was granted by the competent authorities. The planned staff of 100 has been engaged for operation of the installation. As a result of the training course and also because of the various preliminary tests carried out, the personnel is sufficiently skilled to operate the plant. A provisional manual of operations has been drawn up by the KRB staff and with the help of the suppliers. Author

N67-13532# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
A DESIGN STUDY OF A REGENERATIVELY COOLED NOZZLE FOR A TUNGSTEN WATER-MODERATED NUCLEAR ROCKET SYSTEM
Richard L. Puthoff Washington, NASA, Dec. 1966 35 p refs
(NASA-TN-D-3771) CFSTI: HC $2.00/MF $0.50

A parametric study was conducted to meet the design requirements set forth for the tungsten water-moderated nuclear rocket (TWMR). For the design selected, at 100% rocket power, the reference design nozzle coolant pressure drop is 132.3 pounds per inch, coolant temperature increase 119.2°R, and a maximum tube wall temperature of 1820°R. Nozzle performance calculations were also made at rocket reduced power conditions. A regeneratively cooled nozzle was used for the tungsten water-moderated nuclear rocket. Its design involves a computer program which calculates a heat balance at predetermined stations along the nozzle axis. These calculations are summed over the entire nozzle length providing an integrated nozzle coolant pressure drop and temperature increase. R.U.

N67-13544# Reactor Group, United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Materials Lab.
CRITICAL CRACK LENGTH MEASUREMENTS IN HYDRIDED ZIRCALOY-2 PRESSURE TUBES
A. Cowan and K. J. Cowburn 6 Jun. 1966 16 p refs
(TRG-1262(C)) CFSTI: HC $1.00/MF $0.50

Described is the first of a series of tests on Zircaloy-2 pressure tubes containing artificially-introduced, through-wall-thickness, longitudinal slits which have been pressurized to failure. At temperatures up to 300°C failure occured by fast propagation of cracks initiated at the ends of the slits. Increasing the hydrogen content of the tubes causes embrittlement, thus decreasing the critical crack length, i.e. the slit length for failure at a given stress. The embrittlement is greatest at room temperature and ductility increases with temperature until at 300°C the effect of 400 ppm hydrogen is comparatively small. The critical crack length is ≈4in. at the operating temperature and pressure of the S.G.H.W. reactor (300°C, 16,000 lb/in^2), the condition for easiest initiation of a crack from an existing defect. This length is orders of magnitude greater than those which can be detected in service and also greater than the length of through-wall-thickness defects which would be expected to give rise to flow leakage before failure. Over the range measured the critical crack length (l) failure stress (f) relationship approximates to $f^n l$ = constant. The values of n are less than 2, indicating that application of conventional fracture mechanics (n = 2) to tube failure will lead to optimistic estimation of critical crack length. Author

N67-13560# Reactor Group, United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Materials Lab.
THE EFFECT OF VARIATION IN PORE SIZE ON THE RATE OF RADIOLYTIC CORROSION OF GRAPHITE BY CARBON DIOXIDE
V. Y. Labaton, B. W. Ashton, and R. Lind 11 Jul. 1966 23 p refs
(TRG-1006(C)) CFSTI: HC $1.00/MF $0.50

The effect of variation in pore size on the rate of radiolytic oxidation of graphite by carbon dioxide has been investigated by oxidation in the DIDO materials testing reactor of 'A' grade graphite to higher weight losses than previously (final open pore volume (O.P.V.) 35 cm^3/100 g at a weight loss of 28%) and also of a range of graphites with varying pore dimensions and open porosity. It has been shown that, if a substantial proportion of the open pores are larger than a critical size, which is dependent on the gas pressure, the oxidation is less than that predicted from its O.P.V., the results being in accord with estimates of initial lengths for recombination collisions of active species. Author

N67-13599# Polish Academy of Sciences, Cracow.
THERMOSTAT FOR NEUTRON CROSS SECTION MEASUREMENTS WITHIN THE RANGE –196°C TO 200°C [TERMOSTAT DO POMIAROW NEUTRONOWYCH PRZEKROJOW CZYNNYCH W ZAKRESIE TEMPERATUR OD –196° C DO 200°C]
M. Sudnik-Hrynkiewicz, W. Olejarczyk, R. Zieleniewski, A. Szkatula, J. A. Janik et al Sep. 1966 13 p refs Submitted for Publication
(NP-497/PS) CFSTI: HC $1.00/MF $0.50

A thermostat for measuring neutron cross-sections of thin samples with large areas (up to 400 cm^2) at temperatures within the range –196° C to 200° C is described. Constructional details, principles of temperature stabilization and control, and remarks concerning preliminary experiments with the thermostat at the pulsed reactor in Dubna are given. Author

N67-13617# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
THE USE OF ZIRCONIUM ALLOYS IN ORGANIC COOLANTS
J. Boulton Sep. 1966 18 p refs
(AECL-2619) CFSTI: HC $1.00/MF $0.50

The behavior of some zirconium alloys in organic coolants is summarized. By maintaining the water concentration of the coolant in excess of 50 ppm and careful control of chlorine contamination, it is shown that the rate of hydriding of low Ni Zircaloy- or Zircaloy-4 and Zr-2.5% Nb alloy can be held to reasonable limits. It is estimated that Zircaloy-4 or Zr-2.5% Nb alloy should have useful lives, as pressure tube materials, of at least 5 years under WR-1 operating conditions and with Zr-2.5% Nb alloy a useful life of over 1 year as fuel cladding in WR-1. The behavior of a Zr-0.7% Cu-0.2% Fe alloy and Ozhennite 0.5 is also described. Ozhennite 0.5 shows much promise for future development as a possible pressure tube material for organic cooled reactors. Author

N67-13656# Atomics International, Canoga Park, Calif.
1000-MWe FBR PARAMETRIC STUDY OF SECONDARY SODIUM-STEAM SYSTEM
H. B. Holz and G. Schneider 31 Aug. 1966 151 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-12060) CFSTI: HC $5.00/MF $1.00

Cost trends of major plant equipment for the secondary Na steam turbine portions of a LMFBR plant generating approximately 1000 Mwe are described. Eleven different combinations of secondary Na–steam generation systems and turbine plants were studied and compared on a differential cost basis, using a 2400 psi/1000°F–1000°F system as a base case. Incremental energy costs at the intermediate heat exchanger secondary outlet and inlet nozzles of 10, 20, and 30 cents per million Btu were assumed for capitalization of differential heat rates. The energy costs include fuel cycle costs as well as the variable portion of the capital, operation, and maintenance costs for the remaining portion of the plant. NSA

N67-13657# Los Alamos Scientific Lab., N. Mex.
KIWI TRANSIENT NUCLEAR TEST DOSE RATE SURVEY
P. K. Lee and R. V. Fultyn 3 Aug. 1966 51 p
(Contract W-7405-eng-36)
(LA-3519-MS) CFSTI: HC $3.00/MF $0.50

Following the KIWI TNT event, intensive, accurate dose rate surveys were taken of the contaminated areas surrounding the test point. The data collected during these surveys, and decay relations derived therefrom, are presented. Author (NSA)

N67-13680# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
HEAT TRANSFER EXPERIMENTS FOR THE ADVANCED TEST REACTOR
E. D. Waters May 1966 109 p refs
(Contract AT(45-1)-1830)
(BNWL-216) CFSTI: HC $4.00/MF $0.75

Heat transfer experiments were conducted with electrically heated test sections which were full scale models of a typical

coolant channel of the Advanced Test Reactor (ATR). The test section coolant channel was 2.03 in. wide by 0.070 in. thick by 49.5 in. long. A steady state heat conduction analysis of an ATR fuel channel was used to determine the proper size and shape of the resistance heater bars to produce heat flux distribution typical of the reactor fuel elements. A chopped cosine axial heat flux pattern was used in both test sections, and in one test section a lateral flux peaking factor of 1.36 peak/average was also used. A hydraulic analysis was made for the ATR core with many parallel flow channels. The analysis showed that if the hydraulic demand (pressure drop vs flow) curves for any coolant channel exhibited minima (near boiling) which were greater than the constant core pressure drop, then flow instability would occur in that channel and lead to boiling burnout conditions. Experiments were then performed to verify this analysis. Experiments were first conducted to determine hydraulic demand (ΔP vs flow) curves at constant power input rates to the coolant. Coolant velocities from about 1.5 to 5 ft/sec and 25 to 55 ft/sec were used to simulate reactor shutdown conditions and normal reactor operating conditions, respectively. The pressure drop along the test section was recorded as the flow rate was decreased in small steps by a control valve while power input was held constant. Flow reductions were continued until the channel pressure drop reached a minimum and increased appreciably due to boiling and two-phase flow conditions. The experimental apparatus was then arranged to simulate reactor operation with a constant head supplied to the test section. The power input was then increased slowly until flow instability occurred and initiated film boiling conditions. The transient conditions during flow instability were recorded on high speed recorders. NSA

N67-13739# Ente Nazionale per l'Energia Elettrica (ENEL), Latina (Italy).
LATINA NUCLEAR POWER PLANT Annual Report, 1965 [CENTRALE ELETTRONUCLEARE DI LATINA—RELAZIONE ANNUALE 1965]
Brussels, EURATOM, Sep. 1966 58 p In ITALIAN; ENGLISH summary
(Contract EURATOM-002-61-12 REPI)
(EUR-3115.i) CFSTI: HC $3.00/MF $0.50

The report contains, alongside certain conclusions in summary form on the experience acquired during the second year of operation, with particular reference to plant availability and fuel behavior, the entire production data for 1963, 1964 and 1965, as well as the on-stream, down-time and average and monthly utilization factors for 1965. The account of the general principles adopted in the maintenance schedule carried out in the period May–June 1965 is followed by the list of main handling and maintenance operations together with a series of statistics on the personnel employed and periods of duty, broken down by department and installation. For core operation, the main data are given on fuel cycle, absorber cycle and desplittering operations. Chemical control of the primary coolant, boiler maintenance and active waste processing are dealt with in a special chapter on plant chemistry. With regard to health physics, a list is given of the main radiological protection operations accompanied by the figures showing doses received by personnel, broken down by groups, in 1965. The appendix contains monthly graphs showing thermal power, electrical output and position of the sectoral and general rods of group 8. Author

N67-13740# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
BACCHUS—A BURN-UP CODE FOR CONTINUOUS CHARGE-DISCHARGE FUEL CYCLES
L. Massimo Brussels, EURATOM, Sep. 1966 14 p refs
(EUR-3076.e) CFSTI: HC $1.00/MF $0.50

The Bacchus code has been developed to calculate continuous charge–discharge fuel cycles in various reactor types with different fuels, including cases where the neutron spectrum is strongly distorted as for instance with Pu fuel in under-moderated reactors. Because of this reason the spectrum calculation is performed with 68 fast and 96 thermal groups. The fine structure of the flux in the cell can be taken into account with previously calculated concentration-dependent self-shielding factors. The code can deal with fuel reprocessing and seed and breed concepts. Up to 50 isotopes can be treated separately in the burn-up equations. The most important feature of this code is the possibility of considering self-shielding variations during the fuel element life-time. This made difficult an analytical solution of the burn-up equations so that a numerical solution by finite-difference approximation has been used. Typical results are discussed for the case of Pu–Th fuel cycles in high temperature graphite reactors with particular attention to the effects of self-shielding variation. Author

N67-13961# Atomic Weapons Research Establishment, Aldermaston (England).
URANIUM-FUELLED VERA REACTOR EXPERIMENTS
M. H. McTaggart, H. Goodfellow, W. J. Paterson, and J. W. Weale Jul. 1966 89 p refs Submitted for Publication
(AWRE-R-5/66) HMSO: 12s

These experiments form part of a series designed to obtain information against which the nuclear data for ^{235}U and ^{238}U can be checked over the energy range 10 to 500 keV. Seven fast reactor assemblies are described. All the cores contained ^{235}U and graphite, and some also contained ^{238}U and H_2. Detailed measurements were made on four of the assemblies but for the other three assemblies the critical masses only were measured. Author (NSA)

N67-13962# Bettis Atomic Power Lab., Pittsburgh, Pa.
ANGLE-SPACE SYNTHESIS: AN APPROACH TO TRANSPORT APPROXIMATIONS
S. Kaplan, J. A. Davis, and M. Natelson May 1966 49 p refs Presented at the Am. Nucl. Soc. Meeting, Denver, Jun. 1966 Submitted for Publication
(Contract AT(11-1)-GEN-14)
(CONF-660606-14; WAPD-T-1890) CFSTI: HC $2.00/MF $0.50

Three new ideas are combined to produce an analytical approach to solution of the neutron transport equation in realistic multidimensional reactor geometries. The method is of the expansion approach type in which the flux is represented by a linear combination of known functions of angle with mixing coefficients which are unknown functions of space. The mechanics of the new approach are developed in detail and some initial numerical examples are described. NSA

N67-13963# Oak Ridge National Lab., Tenn.
ABNORMAL REACTOR OPERATING EXPERIENCES
Aug. 1966 106 p refs Submitted for Publication
(Contract W-7405-ENG-26)
(ORNL-NSIC-17) CFSTI: HC $4.00/MF $0.75

Information prepared by the Division of Operational Safety since 1963 in memorandum form on unusual reactor operating experiences is compiled and indexed. Seven licensed reactor experiences issued by the AEC Regulatory Staff are also included. NSA

N67-13973# Atomic Energy Commission Research Establishment, Riso (Denmark).
STUDY OF A PROPOSED HEAT TRANSFER EXPERIMENT WITH A MULTIROD ELEMENT, DOR DESIGN STUDY
Rolf Andersen and Carl B. Moyer 1966 140 p refs Submitted for Publication
(RISO-124)

Various considerations pertinent to the design of experiments to obtain heat transfer information about the DOR 19-rod bundle

fuel element are described. A comparison of analyses and data available in the literature shows that the lumped parameter or finite difference type of analysis can yield fairly accurate predictions of canning temperatures. Applied to typical DOR cases, the analysis predicts peripheral canning temperature variations of approximately 5°C about the mean provided that the fuel rods are properly aligned. A study of experimental methods suitable for simulating DOR reactor conditions indicates that no heating method can be designed at this time with any real assurance that it will provide an adequate simulation. A laboratory development program could probably lead to such a heater, but the time and expense involved would seem to be considerable. It is recommended that a simulation experiment not be attempted, and that the final verification of the fuel element heat transfer should be made as an in-pile experiment. Author (NSA)

N67-13975# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JUNE 1966
Albert Crewe and Stephen Lawroski 27 Jul. 1966 96 p refs Submitted for Publication
(Contract W-31-109-ENG-38)
(ANL-7230) CFSTI: HC $3.00/MF $0.75

Items of significant technical progress which have occurred in the specific reactor projects and the general engineering research and development programs are reported. Operation of the EBR-II, fast reactor physics, fuel development and reprocessing, and Na technology are described for the liquid metal cooled reactor program. Work under the general reactor technology program includes studies of theoretical reactor physics, high temperature materials, fuels and materials, engineering, chemical separations, and the plutonium recycle experiment. The argonne advanced research reactor and liquid metal fast breeder reactor development is reported. Nuclear safety studies include reactor kinetics, TREAT operations, energy transfer problems in reactor safety, and Pu volatility experiments. NSA

N67-13976# Brookhaven National Lab., Upton, N. Y.
THE EFFECT OF XENON ON SAFETY OF THE HFBR
G. Lellouche and J. Chernick Jul. 1966 10 p Presented at the Ann. Meeting of Am. Nucl. Soc., Denver, 20–23 Jun. 1966 Submitted for Publication
(Contract AT(30-2)-GEN-16)
(CONF-660606-16; BNL-10388) CFSTI: HC $1.00/MF $0.50

The equations for the line model of reactor dynamics are presented and used to indicate the effect of xenon on High Flux Beam Reactor transients. NSA

N67-13977# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NEUTRONICS CHARACTERISTICS OF POSSIBLE DRIVER FUELS FOR THE FAST TEST REACTOR (FTR)
W. W. Little, Jr. and R. W. Hardie May 1966 29 p refs Submitted for Publication
(Contract AT(45-1)-1830)
(BNWL-281) CFSTI: HC $2.00/MF $0.50

The principal neutronics characteristics of 14 possible driver fuels for the Fast Test Reactor (FTR) are described. The fuels considered are PuO_2–SS cermets, $(Pu–U)O_2$ and (Pu–U)C ceramics, and Pu–U–Zr metals. For each fuel, core volumes of 600 and 800 liters are studied. The cermet fueled reactors are found to produce the highest flux for a given power density. Unmoderated 600 and 800 liter ceramic fueled reactors appear to have only a marginal Doppler coefficient. The Doppler coefficient can be significantly increased by adding BeO to the core. Author (NSA)

N67-13980# General Dynamics Corp., San Diego, Calif. General Atomic Div.
THE HTGR COATED PARTICLE FUEL
W. V. Goeddel and J. C. Bokros 15 Mar. 1966 27 p refs Presented at the Aime Nucl. Met. Symp., Delavan, Wis., 1966 Submitted for Publication
(Contract AT(04-3)-167)
(CONF-661003-3; GA-6975) CFSTI: HC $2.00/MF $0.50

Comprehensive studies of coated particle fuels for the HTGR (High-Temperature Gas-cooled Reactor) are described. These studies are directed toward identifying and quantitatively defining the structural and environmental parameters influencing the behavior of pyrolytic-carbon-coated carbide fuel particles under conditions of high temperature, high burnup, and fast flux irradiation. Systematic studies of the relationship between the structure of pyrolytic carbon and its behavior under irradiation show that the most irradiation-stable carbon coatings will be those that are free of any preferred orientation, have densities as near theoretical as possible, and have maximum crystallinity to minimize irradiation-induced crystallite strains. Extensive irradiation testing of pyrolytic-carbon-coated carbide fuel particles shows that their stability is dependent on both environmental conditions (temperature and burnup) and material parameters (coating structure and geometry). Two- and three-layer pyrolytic-carbon coatings that have a low-density innermost layer and high-density isotropic outer layers have shown good stability during 10% to over 20% burnup at temperatures to over 1400°C. Author (NSA)

N67-13984# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
NUCLEAR TECHNOLOGY BRANCHES Quarterly Report, 1 Oct.–31 Dec. 1965
Jun. 1966 56 p refs
(Contract AT(10-1)-205)
(IDO-17191) CFSTI: HC $3.00/MF $0.50

Detailed measurements in the ATR Critical Facility (ATRC) show that flux depression in ATR fuel plates is insignificant. Replacing the 35 kg ^{235}U core in the ATRC with a new 39 kg core resulted in a net increase in excess reactivity of 3.8$, 0.4$ of which was due to the side plate vents in the new fuel elements. A high-temperature, high-pressure loop was installed in the ATRC, and all operational tests were completed. The average temperature coefficient of this loop is approximately $4 \times 10^{-4}$$/° F. Analyses of the thermal-hydraulic-structural performance of the ATR driver fuel elements indicate that an element operating at the maximum power density in either a 40 or 50 Mw lobe probably will be satisfactory. The performance of that element operating at the maximum power density in a 60 Mw lobe is questionable since the yield stress of the unirradiated cladding material is exceeded over the span of the hot plate. Further efforts to assess this result are underway. An attempt to measure the channel thickness in a spent ETR fuel element was made. Pb shielding was introduced in the microprobe and was found to reduce the background noise level from radioactive specimens by 80 to 90 percent. Maximum benefits from the shielding require the selection of the proper spectrometer crystals to diffract the desired X-ray wavelengths in the intermediate-to-high 2θ range. Electron fractography of MTR lattice Be tested under both compressive and Izod loading showed no effect due to the manner of testing, but post-irradiation, pretest annealing caused a slight decrease in the amount of He observed within the grains and a marked increase in the amount of He observed in the grain boundaries. Two versions of the Monte Carlo Program, PMC, are presently complete and are available to ssolve difficult transport theory problems. Both versions have the same geometry subroutines which enable the program to handle difficult three-dimensional geometries without approximation. In the first version, constant multigroup or few-group cross sections are supplied from pre-calculated data. In the second version, a resonance calculation is performed for particles which traverse the resonance range based on single-level, Breit-Wigner resonance

parameters supplied in the input. In both versions, a statistical analysis of all data is incorporated with the output subroutines. The program is written for the IBM 7040 computer.
Author (NSA)

N67-13989# Atomic Energy Establishment, Winfrith (England). Reactor Group.
AN ANALYSIS OF URANIUM METAL-GRAPHITE SYSTEMS USING THE MULTI-GROUP CODE "WIMS"
F. R. Barclay 2 Jun. 1966 26 p refs
(AEEW-R-473) HMSO: 4s

A wide range of U metal-graphite lattice experiments were studied using the WIMS code which has, in its turn, been compared with more exact calculational models in the fast and resonance energy regions. No significant errors in the calculational model were observed. Comparison with experiment shows a systematic error with pitch which is ascribed to an error of some 15% in the best available ^{238}U resonance data. Within this, different sizes and enrichments of fuel rods, and different air channel sizes (streaming) are well predicted.
Author (NSA)

N67-13997# Institutt for Atomenergi, Halden (Norway).
DYNAMICS OF THE HALDEN BOILING WATER REACTOR
T. Eurola Dec. 1965 57 p refs
(HPR-66)

The dynamic behavior of the HBWR system with the second fuel charge is described in the light of experimental results on the unperturbed system and the system responses to various perturbations. The main features of a theoretical model describing the dynamics of a natural circulation boiling heavy water reactor are explained. The model is applied to the HBWR second fuel charge and the calculated and measured values are compared.
NSA

N67-14002# General Electric Co., San Jose, Calif.
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR DEVELOPMENT PROGRAM Quarterly Report, 1 Feb.–30 Apr. 1966
K. M. Horst, comp. May 1966 124 p refs
(Contract AT(04-3)-540)
(GEAP-5160; QR-8) CFSTI: HC$4.00/MF$0.75

Progress in the preoperational research and development program of the SEFOR project is summarized. Program tasks described include: experimental program planning, experiments performed in the ZpR-III, fuel development, special instrumentation, steady-state and transient characteristics of the core assembly, reactivity controls required for experimentation, fuel handling, core design, and fuel fabrication.
NSA

N67-14005# Argonne National Lab., Ill.
CATALOG OF NUCLEAR REACTOR CONCEPTS. PART I: HOMOGENEOUS AND QUASI-HOMOGENEOUS REACTORS.
Charles E. Teeter, James A. Leckey, and John H. Martens Jun. 1966 71 p refs
(Contract W-31-109-ENG-38)
(ANL-7228) CFSTI: HC$3.00/MF$0.75

Reactor concepts in which the solid fuel and moderator are in a uniform combination or mixture are cataloged. The concepts are separated into reactors designed for research and testing and for power production and breeding.
NSA

N67-14017# Atomic Power Development Associates, Inc., Detroit, Mich.
FACILITIES, CAPABILITIES, AND EXPERIENCE IN LIQUID METALS AND FAST REACTOR RESEARCH AND DEVELOPMENT
Jun. 1966 94 p refs
(Contract AT(11-1)-865)
(APDA-TPI-1) CFSTI: HC$3.00/MF$0.75

The research, design, and developmental work performed by Atomic Power Development Associates is summarized for the liquid metal-cooled fast breeder reactor concept. Most of the work is directly related to the development of the Enrico Fermi Atomic Power Plant and includes: reactor physics and related calculations, development of fuel, shielding, and reactor materials, fuel element design, reactor design, and design of the heat transport system and related system components.
NSA

N67-14029# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
SHIELDING HIGH-ENERGY ELECTRONS: THE NEUTRON AND MUON COMPONENTS [ABSCHIRMUNG HOCHENERGETISCHER ELEKTRONEN: DIE NEUTRONEN- UND MYONENKOMPOENTE]
G. Bathow, E. Freytag, and K. Tesch Jul. 1966 18 p refs In GERMAN; ENGLISH Summary
(DESY-66/18)

Heavy concrete shielding measurements were extended to thicknesses from 200 to 400 cm using 4- and 6-Bev electron beams. High energy neutrons and secondary low energy neutrons as well as muons were measured. Flux densities, attenuation coefficients, and lateral distributions are given. The experimental results agree with the estimates.
Author (NSA)

N67-14030# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
DEVELOPMENT OF PULSED NEUTRON APPLICATION TO POWER REACTOR START-UP PROCEDURES Quarterly Progress Report No. 16, 1 Jan.–31 Mar. 1966
E. Garelis and P. Meyer Apr. 1966 19 p refs
(Contract AT(04-3)-189)
(GEAP-5145) CFSTI: HC$1.00/MF$0.50

The merits of using a pseudo random neutron source excitation to measure reactor impulse response functions was investigated. A theoretical and experimental study is conducted, and results of the initial measurements are shown and discussed. As part of the theoretical development, the approach to obtain an exact solution of the time-dependent kinetic problem of a multiregion pulsed assembly is described, using a one-group symmetrically reflected diffusion theory model.
Author (NSA)

N67-14031# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
COMPARISONS OF THEORETICAL LAPLACIAN OF HEAVY-WATER REACTOR LATTICE WITH THE MEASUREMENTS OF THE CRITICAL ASSEMBLY [SROVNANI TEORETICKEHO VYPOSTU LAPLASIANU MRIZE TEZKOVODNIHO REAKTORU S MERENIM NA KRITICKEM SOUBORU]
P. Sulc 1966 32 p refs In CZECHOSLOVAKIAN; ENGLISH summary
(UJV-1424)

A comparison between the calculated and measured Laplacian of a heavy water gas-cooled lattice cell with natural U fuel is given. The method of the correlation of the program PARAMETRY II is discussed together with the deficiencies of the calculational method. An estimate of the influence of incorrect values of some physical constants and geometrical characteristics on the Laplacian is made. In the conclusion some recommendations concerning the improvement of the calculational method are added and attention is devoted to necessarily extension of the experimental material.
Author (NSA)

N67-14048# Oak Ridge National Lab., Tenn.
AN INTERVAL TIMER DESIGNED FOR USE DURING IRRADIATIONS AT THE HEALTH PHYSICS RESEARCH REACTOR

J. H. Thorngate Aug. 1966 26 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1559) CFSTI: HC $2.00/MF $0.50

An inexpensive, reliable timer was designed and constructed that allows reactor runs to be timed from an arbitrary starting point for periods up to 27 hours. Timing precision to 2.7 hours is 1 second and is 10 seconds up to 27 hours. Accuracy depends upon the constancy of the 60-Hertz line frequency but is within one cycle of this frequency. Manual timing of arbitrary reactor runs is also possible with this device as the timer will always stop when a reactor shutdown occurs whether or not the timer is controlling the reactor. Author (NSA)

N67-14055# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
MEASUREMENT OF NEUTRON DENSITY DISTRIBUTIONS IN MULTILAYER UNIT CELLS II: RESULTS FOR ANNA REACTOR CELL WITH WATER, 14.0 CM LATTICE PITCH
L. Adamski, E. T. Jozefowicz, K. Jozefowicz, and A. Szechter Mar. 1966 20 p refs
(INR-698/IX-A/AR)

Neutron density distribution in the ANNA elementary cell, using water moderation and 14.0 cm lattice pitch, was measured using the spiral wire detector method. The results are given in the form of distributions of bare and subcadmium Cu activities. A discussion of experimental errors and difficulties of the method is included. Author (NSA)

N67-14056# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PHYSICS EXPERIMENT: HIGH POWER DENSITY CORE OF THE PRTR
J. R. Worden, W. L. Purcell, and L. C. Schmid Jan. 1966 33 p refs
(Contract AT(45-1)-1830)
(BNWL-221) CFSTI: HC $2.00/MF $0.50

A high power density (HPD) core is described for the Plutonium Recycle Test Reactor. The core consists of 54 clusters of UO_2-2 wt % PuO_2 fuel elements. The experimental program with the HPD core is designed to determine both the excess reactivity and fuel composition of the core as functions of time. The core will be irradiated in increments of 2 months duration, at which time fuel rods will be selected for isotopic analysis. Critical experiments will also be performed to determine reactivity coefficients associated with core burnup. NSA

N67-14057# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
STEP PROJECT
K. A. Dietz, ed. Jul. 1966 83 p refs
(Contract AT(10-1)-205)
(IDO-17165) CFSTI: HC $3.00/MF $0.75

A steady-state power test, coupled-drum impulse transient tests, and cascaded step transient tests were conducted in the SNAPTRAN-1 experimental test program. The steady-state power test was conducted to determine the effect of ambient temperature changes in the core on the base reactivity and to calibrate nuclear instrumentation. The isothermal temperature coefficient of −0.11 cent/°F was associated with the ambient temperature condition of the reactor core. The coupled-drum impulse transient tests were conducted to investigate the reactivity feedback behavior under conditions approaching reactor self-destruction, and the cascaded step transient tests were conducted to determine the feedback coefficient for average core temperatures in excess of 1200°F. H_2 pressure in SNAPTRAN fuel was measured during the SNAPTRAN-1 transient tests to obtain an understanding of the dynamics of hydrogen release from the ZrH lattice. The information obtained from the measurements was used in predicting the fuel behavior at energies which cause fuel damage. The SNAPTRAN-2 reactor and control systems were modified to ensure that the maximum reactivity could be inserted during the destructive test. Author (NSA)

N67-14058# Southwest Research Inst., San Antonio, Tex.
INVESTIGATION OF THE FABRICATION AND INSTALLATION OF THE LACBWR REACTOR PRESSURE VESSEL
Paul D. Watson 4 Aug. 1966 15 p ref
(Contract AT(11-1)-1228)
(SWRI-1228-7-33) CFSTI: HC $1.00/MF $0.50

Fabrication specifications for the LaCrosse Boiling Water Reactor Pressure Vessel were reviewed, and the fabrication and erection operations were monitored. Some fabrication problems and their resolution are discussed. It is concluded that the fabrication and erection of the vessel assembly was performed satisfactorily in accordance with the specifications. NSA

N67-14059# Southwest Research Inst., San Antonio, Tex.
EVALUATION OF THE SERVICEABILITY OF THE ELK RIVER REACTOR PRESSURE VESSEL Quarterly Report, Apr. 1–Jun. 30, 1966
C. E. Lautzenheiser 1 Aug. 1966 21 p
(Contract AT(11-1)-1228)
(SWRI-1228-4-22) CFSTI: HC $1.00/MF $0.50

The work includes the study of the fatigue properties of steels and weldments, and the study of neutron irradiation effects on the ductility and fatigue properties of steels and welds, and the development of remote nondestructive testing methods for the Elk River Reactor Pressure Vessel. NSA

N67-14060# Oak Ridge National Lab., Tenn.
TEMPERATURE DISTRIBUTION UNDER DIMPLES PROPOSED AS SPACERS IN THE BONUS SUPERHEATER ASSEMBLIES
J. P. Sanders 22 Apr. 1966 14 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1453) CFSTI: HC $1.00/MF $0.50

It has been proposed that dimples in the coolant tube be used as an alternative to the present space ring to center the clad fuel rod in the coolant stream in the BONUS super-heater assemblies. The temperature distribution under such a dimple was investigated using the HEATING code. Calculations were made in two dimensions using cylindrical geometry and a 78.5° segment. It was found that lateral conduction could not dissipate heat from beneath the dimple sufficiently well to maintain temperatures in the cladding less than 1250°F. The only method of maintaining sufficiently low temperatures in the cladding was to insure good thermal contact between the cladding and the dimple. Sufficient contact might be obtained by placing three dimples around the same perimeter and constructing them to obtain an interference fit at the three points of contact. The dimples might be slightly flattened to the curvature of the fuel rod at the point of contact, and both metal surfaces should be clean and free of oxide film. Author (NSA)

N67-14061# Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria). Institut fuer Chemie.
STUDY OF THE FISSION PRODUCT DISTRIBUTION IN THE COATING OF FUEL ELEMENTS FOR HIGH TEMPERATURE REACTORS [UNTERSUCHUNG UEBER DIE SPALTPRODUKTVERTEILUNG IN DER BESCHICHTUNG VON BRENNSTOFFTEILCHEN FUR HOCHTEMPERATURREAKTOREN]
L. Szterk and H. Bildstein (Inst. fuer Atomkernforsch.) 1966 28 p refs In GERMAN; ENGLISH summary Submitted for Publication Supported in part by Intern. Atomic Energy Agency
(SGAE-CH-33/1966)

A method was developed for the determination of fission product distribution in the coating of fuel particles for high-temperature reactors, which permits a selective, stepwise dissolution of the

various coating layers. By gamma spectrometry of the etching solutions fission product profiles can be determined. The basic development was followed by the application of the procedure on the investigation of two types of coated particles of PyC/SiC/PyC-coatings, irradiated to 16% fifa at a temperature of 1400°C max. As the cooling times of the samples were more than 1-1/2 years, distribution could be determined only for long lived nuclides (Zr, Ru, Cs and Ce). Author (NSA)

N67-14081# California Univ., Livermore. Lawrence Radiation Lab.

INDUSTRIAL APPLICATIONS OF CONTAINED NUCLEAR EXPLOSIONS

Donald E. Rawson Jul. 1966 59 p refs
(Contract W-7405-ENG-48)
(UCRL-14756) CFSTI: HC$2.00/MF$0.75

The phenomena and technology of contained (nonexcavation) nuclear explosions as they relate to potential industrial uses are summarized. The results of nuclear explosions of a given yield, at a given depth, and in a known geologic setting are understood sufficiently that further explosions can be conducted safely and, within limits, the characteristics of the resulting environment can be predicted. The features of contained nuclear explosions that should be of most interest to industry are (1) the creation of a large void underground in the form of a cavity generated by the explosion. This void becomes distributed between rubble fragments when the roof of the unstable cavity collapses; (2) the creation of a large amount of fragmented rock distributed within a chimney that develops as a result of the collapse of the roof of the cavity; (3) the fracturing of rock surrounding the cavity-chimney region and associated increased permeability in most rock types. To illustrate the magnitudes of these effects, a 100-kiloton explosion at a depth of 900 meters (3000 feet) will produce a cavity with a radius of about 45 meters (148 feet) or a void volume of 1.23 million cubic meters (43.5 million cubic feet). Cavity roof collapse will extend about 194 meters (635 feet) above the explosion center and will contain 1.61 million tons of rubble. About ten times this tonnage may be cracked and become more permeable. The environment resulting from a contained nuclear explosion has applications leading to the recovery of oil natural gas, water, and geothermal energy; to the underground storage of oil, natural gas, water, and compressed air; and to the disposal of fluid waste.
Author (NSA)

N67-14085# United Kingdom Atomic Energy Authority, Springfields (England). Reactor Group.

THE MECHANISM OF FAILURE IN UO_2 STAINLESS STEEL CERMETS

J. H. Gittus 12 Jul. 1966 8 p refs Previously Published as TRG Memorandum 1249(S), Sep. 1962
(TRG-1278(S); TRG-Memo-1249(S))

A model is proposed for explanation of the irradiation-induced failure of UO_2-stainless steel cermets in terms of the growth of fission-gas bubbles in the damage halos surrounding the fissile particles. A numerical elaboration of the failure model leads to the criterion: $(B\theta)^{3/2}\, t \exp(-Q/\theta) > kV_{lim}$ where B is burn-up, θ is the absolute temperature, t is the time, Q is half the activation energy for bubble nucleation, V_{lim} is a limiting value of the total volume of gas in bubbles, and k is a constant. The model can be used to discriminate between failures and non-failures. Author (NSA)

N67-14087# Southwest Research Inst., San Antonio, Tex.

LOW-CYCLE FATIGUE STRENGTHS OF DISSIMILAR WELDMENTS Topical Report No. 3

J. Mc Donald and P. D. Watson 23 May 1966 65 p refs
(Contract AT(11-1)-1228)
(SWRI-1228-4-20) CFSTI: HC$3.00/MF$0.75

Investigations were made to determine the low cycle fatigue strength of weldments that simulate the A105 Grade II-to-Type 304 stainless steel dissimilar welds now in service on the Elk River Reactor. The weldments simulated were 8 and 10-in nozzle-to-external piping welds, 16-in nozzle-to-cap welds (as welded), and 16-in nozzle-to-cap welds (stress relieved). Low cycle fatigue curves were developed for all three types at both ambient and elevated temperatures (600°F). In addition, the effects of superimposed fatigue-thermal cycling (simulating reactor startup and shutdown) were determined. The fatigue curves developed in this phase of the program will be used as standards for the post-irradiation tests to be performed on the dissimilar weld surveillance specimens. Author (NSA)

N67-14091# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.

EXPERIMENTS TO EVALUATE REACTIVITY COEFFICIENTS WITH REACTOR OPERATING AT STEADY STATE CONDITIONS (STATIC EXPERIMENTS)

L. Caldarola, W. Haefele, and W. Schikarski Feb. 1966 42 p refs Sponsored by EURATOM
(KFK-260)

Three reactivity coefficients are defined: the global power coefficient referred to the reactor power, the global coolant temperature coefficient referred to the average coolant temperature, and the secondary radial expansion temperature coefficient referred to the coolant temperature rise in the reactor. Each coefficient is measured by a separate experiment in which the reactivity effects due to the other two are made equal to zero. The error analysis is developed with numerical examples referred to the Southwest Experimental Fast Oxide Reactor (SEFOR). With the aim of minimizing the total error, attention is given to the choice of the best power interval for the measurement of the global power coefficient. The control philosophy of the reactor system during the experiments is also studied. Author (NSA)

N67-14106*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DIGITAL CODES FOR DESIGN AND EVALUATION OF CONVECTIVELY COOLED ROCKET NOZZLE WITH APPLICATION TO NUCLEAR-TYPE ROCKET

John E. Rohde, Rudolph A. Duscha, and George Derderian Washington, NASA, Jan. 1967 91 p refs
(NASA-TN-D-3798) CFSTI: HC$2.50/MF$0.75 CSCL 21F

The design of the coolant passages of a convectively cooled nozzle is dictated by heat-transfer and flow considerations that are compatible with the overall rocket system and acceptable stresses within the nozzle structure. The method presented for designing this type of nozzle utilizes both a design and an evaluation computer program used in conjunction. These digital computer programs are coded in FORTRAN IV for use on an IBM 7094 computer. The design program calculates coolant passage dimensions for a specified gas-side wall temperature distribution, and the evaluation program calculates a gas-side wall temperature distribution for specified coolant-passage dimensions. In addition, coolant conditions are calculated, and all heat-transfer and fluid flow results are utilized to calculate coolant-passage tangential and longitudinal stresses. The programs are set up to utilize a range of heat-transfer correlations, different tube surface roughness conditions, and a tube splice. The evaluation program has the additional capability to handle radial or flat-plate heat conduction across the tube crown and the application of a coating to the gas side of the coolant passage. Application of these programs is shown for the design and the evaluation of a nuclear-type rocket nozzle operating at chamber conditions of 4000°R and 530 pounds per square inch absolute with hydrogen as both the coolant and the propellant. The wide range of available heat-transfer correlations for both the hot-gas and coolant sides and the conduction model used across the tube crown result in maximum gas-side wall temperatures ranging from 1550° to 2250°R. Author

N67-14131# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
INVESTIGATION OF THE COMBINED FAILURE OF A PRESSURE TUBE AND DEFECTED FUEL ROD IN PRTR
M. D. Freshley, R. G. Wheeler, J. M. Batch, and G. M. Hesson
13 May 1966 151 p refs
(Contract AT(45-1)-1830)
(BNWL-272) CFSTI: HC $5.00/MF $1.00

An incident involving the rupture of an intentionally defeated HPD UO_2–PuO_2 fuel rod and a Zircaloy pressure tube occurred in the Fuel Element Rupture Test Facility of PRTR. Evaluations of the fuel, pressure tube, and thermal-hydraulic conditions were made. A possible rupture mechanism is proposed. NSA

N67-14137# Atomic Energy Commission, Washington, D. C. Fuels and Materials Branch.
LIQUID SODIUM METAL COOLED FAST BREEDER REACTOR (LMFBR) PROGRAM Fuels and Materials Summary Report
Jan. 1966 41 p
(WASH-1065) CFSTI: HC $1.00/MF $0.50

The status of fuels and materials technology in the LMFBR program is reviewed and evaluated. Two metal fuel alloys that show promise are (U-Pu)Zr and (U-Pu)Ti. The U-Pu oxides and carbides currently offer the best potential for fast reactor fuel. Both fuels and cladding development are hampered by the lack of fast flux irradiation facilities. Limitations of the existing fast reactors, EBR-II and Fermi, make the design and construction of an adequate fast facility imperative to the development of economical and reliable fuels and materials. NSA

N67-14141# Aktiebolaget Atomenergi, Stockholm (Sweden).
BUCKLING MEASUREMENTS UP TO 250°C ON LATTICES OF AGESTA CLUSTERS AND ON D_2O ALONE IN THE PRESSURIZED EXPONENTIAL ASSEMBLY TZ
R. Persson, A. J. W. Andersson, and C.-E. Wikdahl Nov. 1966 57 p refs
(AE-254) CFSTI: HC $3.00/MF $0.50

Buckling determinations by means of flux mapping were performed in TZ up to 250°C on two lattices of Agesta fuel assemblies in D_2O and on D_2O alone. Most of the flux measurements were made with fission counters in pressure thimbles. The perturbations caused by the thimbles were studied experimentally in various ways and compared with two-group diffusion-theory calculations. In one of the lattices the effectiveness of a control rod (AgInCd) was also investigated. The results of the diffusion length experiments indicated some systematic error of the order of 0.15–0.10 m^{-2} in the bucklings measured, though the temperature dependence should be well established. The bucklings of the two lattices studied were found to be less sensitive to temperature than theoretical calculations predict, the temperature coefficient being more than 10 percent smaller. The buckling changes from 20° to 250°C were about −2.4 and −1.8 m^{-2}, respectively, for the two lattices. During part of the experimental period there was, for some unexplained reason, about 30 percent excess absorption in the heavy water. Author

N67-14162# Atomic Energy Establishment, Winfrith (England). Technical Assessments and Services Div.
AN INVESTIGATION OF DIFFERENCES BETWEEN MEASURED AND CALCULATED BUCKLINGS OF A SERIES OF LIGHT WATER AND HEAVY WATER MODERATED EXPERIMENTAL CORES
A. J. G. Figgins (Babcock and Wilcox, Ltd.) Feb. 1966 40 p refs
(AEEW-R-467) HMSO: 5s 6d

A series of light and heavy water moderated exponential and critical experiments were analyzed using the METHUSELAH program and it was found that the calculated and measured critical bucklings differed significantly. The effect was most marked as the temperature of the moderator was raised in the light water cores where it amounted to 10 m^{-2} for a 200°C rise above room temperature. Of this discrepancy 3 m^{-2}, at the most, could be explained as being caused by the experimental cores not being large enough to have a central asymptotic region, leaving an unexplained difference of 7 m^{-2}. It is suggested that the only region in which METHUSELAH could be usefully modified to improve this agreement is in the calculation of the resonance escape probability. The last section of the report compares the calculated and measured results obtained at room temperatures. Author

N67-14166# United Kingdom Atomic Energy Authority, Springfields (England).
THE IRRADIATION BEHAVIOUR OF URANIUM CARBIDE/SILICON CARBIDE DISPERSED FUELS
J. V. Shennan, F. Sterry, and H. J. De Nordwall 1966 37 p refs
(TRG-1213(S)) HMSO: 7s

The irradiation behavior of UC/SiC dispersed fuel rods incorporating silicon carbide and pyrocarbon coated uranium carbide spheres has been investigated in low- and high-temperature capsules in the materials testing reactor and also in the HTGC loop in the PLUTO reactor. Excellent results have been obtained for fuel rods containing pyrocarbon coated particles in all three types of experiment. Irradiations of fuel containing silicon carbide coated particles have generally suffered from overheating effects in both HPD and PLUTO loop experiments, when cracking of the silicon carbide matrix occurs under the stresses produced by cycling the rods through the melting point of silicon (1410° C). However, irradiation results at low temperatures (700–800° C) suggest that silicon carbide coated fuel is inferior to pyrocarbon coated fuel. Metallographic examination reveals a much greater extent of matrix cracking, the cracks apparently being initiated at the coat-kernel interface, and there was an associated increase in the release of fission products. It is though that cracking results from stresses set up in the inner layers of the coat by fission-fragment damage, which in the case of pyrocarbon are relieved by densification processes resulting in the phenomenon of 'spearhead' attack. Author

N67-14336# Gemeenschappelijke Kernenergiecentrale Nederland, Dodewaard.
50 MWe DODEWAARD NUCLEAR POWER PLANT Annual Report 1965 [KERNENERGIECENTRALE VAN 50 MWe TE DODEWAARD Jaarverslag 1965]
Brussels, EURATOM, Sep. 1966 60 p In DUTCH; ENGLISH summary
(Contract EURATOM-006-63-4 REPN)
(EUR-3116.n) CFSTI: HC $3.00/MF $0.75

Progress is reported in the development and operation of a nuclear power plant. Shielding studies were conducted which resulted in determinations of criteria for the permissible radiation level and definition of the non-accessible areas during reactor operation. A brief description is given of the containment system, together with a specification of material requirements with which fabrication must comply. Materials, design work, and calculations performed on the reactor pressure vessel are described. A brief discussion is given of the turbine installation, the measures taken to prevent leakage of radioactive steam, the condensation unit, feedwater preheating, circuits, and the by-pass system. The wiring and the preparatory work for determining the necessary instrumentation are covered. A review of the preliminary experimental program is included.
C.T.C.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N67-13384# Brookhaven National Lab., Upton, N. Y.
COMBINATION OF CYLINDRICAL CURRENT SHEETS TO CANCEL EXTERNAL FIELD
R. A. Beth 29 Mar. 1966 5 p ref
(Contract AT(30-3)-GEN-16)
(BNL-10143) CFSTI: HC $1.00/MF $0.50

It was shown previously that any required finite two-dimensional magnetic field can be produced inside or outside a right circular cylinder by letting the proper current distribution flow along the elements of the cylinder. It is shown that by using two coaxial cylinders, the external magnetic field can be cancelled and an arbitrarily required internal field can be produced. NSA

N67-13624# Brookhaven National Lab., Upton, N. Y.
CALCULATIONS OF HARD SPHERE PACKINGS IN LARGE CYLINDERS
B. E. Clancy Jun. 1966 23 p refs
(BNL-997(T-424) CFSTI: $2.00

A procedure is described for generating numerical models of various arrangements of hard spheres packed in a cylindrical vessel. Calculations of a variety of configurations have been carried out on a digital computer for two packing models. The results are compared with measurements of the packing density in experimental configurations and with other measured properties of the packings. Author (NSA)

N67-13666*# Stanford Univ., Calif. Microwave Lab.
INVESTIGATION OF COHERENT SOURCES OF INFRARED RADIATION Semiannual Status Report, 1 May–31 Oct. 1966
A. L. Schawlow Nov. 1966 9 p refs
(Grant NGR-05-020-166)
(NASA-CR-80726; SASR-1; ML-16488) CFSTI: HC $1.00/MF $0.50 CSCL 20F

The status of investigations of the calcium niobate (CN) radical as the active species of a coherent infrared source is reported. Stimulated emission was observed between states in an effort to gain a net shift in a magnetic field, thus providing a tunable infrared source. The findings of other authors on laser line state assignments and the population inversion mechanism are reviewed. Three experimental approaches for studying the population inversion and stimulated emission kinetics are briefly mentioned: (1) study of the Zeeman behavior of laser emission; (2) study at optical and infrared frequencies the time-dependent behavior of levels important to proposed laser excitation and relaxation mechanisms; and (3) study of fine structure splitting in the 3 to 30 MHz region through a beat frequency technique. K.W.

N67-13682# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
AN INTRODUCTION TO PLASMA PHENOMENA
Morrel P. Bachynski *In its* Plasma Phys. Res. and Eng. 1966 p 3–6 refs (See N67-13681 04-25)

In this basic tutorial approach to plasma phenomena from the engineering viewpoint, the fundamental properties of a plasma are examined. Interaction with electric and magnetic fields, and collisions between plasma constituents are also considered, along with the waves and small amplitude perturbations which occur in plasma. The conditions under which a sheath is created are defined; a figure is included to depict sheath formation at the boundary between a conductor and a plasma. The plasma parameters found in nature are tabulated. Two developments are identified as resulting in a host of plasma problems: (1) the possibility of generating energy by the fusion of nuclei of the light elements; and (2) the capability of propelling vehicles at high velocities and into outer space. Possible earth uses for plasma-like devices are mentioned. Also included is a log–log plot of various plasmas in terms of electron density, temperature, and Debye length. M.G.J.

N67-13705# Lockheed Missiles and Space Co., Palo Alto, Calif.
EXCITATION OF A SMOOTH PERFECTLY CONDUCTING BODY OF REVOLUTION, I
E. N. Vasil'ev [1966] 9 p refs Transl. into ENGLISH from Izv. Vyssh. Uchebn. Zavad., Radiofiz. (Gor'kiy), v. 2, no. 4, 1959 p 588–595

A numerical method, using integral equations and applicable to a body of revolution of arbitrary shape, is proposed to compute the current distribution on the body of revolution excited by an electromagnetic wave. The application of integral equations for external excitation problems is convenient in that it assists in reducing the three-dimensional problem in an infinite domain to a two-dimensional problem on a bounded surface. Transformation of the integral equation is detailed, and its kernel is investigated. Since the integral solutions are carried out separately for each harmonic of current density, electric and magnetic fields are also calculated in the form of azimuthal harmonics. M.W.R.

N67-13708# Lockheed Missiles and Space Co., Palo Alto, Calif.
PLANE SHOCKWAVE IN A PLASTIC MEDIUM
E. I. Andriankin [1966] 7 p refs Transl. into ENGLISH from Tr. Mosk. Fiz. Tekhn. Inst. (Moscow), no. 4, 1959 p 144–151

Plane shock wave propagation is studied in a plastic medium with variable compression dependent on the amplitude of the pressure on the wave front, and consideration is given to the case when a constant amplitude sound wave overtakes the front of a strong discontinuity. Propagation arising because of the explosion of a charge disposed between two planes is investigated, and the propagation law for the plastic-wave front is shown schematically. The motion and continuity equations are written as Lagrange variables for the problem that arises prior to the time of sound radiation; and the conservation laws on the wave front, the continuity condition of the moving radius, and the equality of the pressure on the boundary of the expanding cavern become the boundary conditions. An asymptotic formula is then obtained for the wave-front velocity; and a solution as a series, each of whose members satisfies the homogeneous boundary conditions, is found. M.W.R.

N67-13793*# National Aeronautics and Space Administration, Washington, D. C.
NEW METHOD IN THE THEORY OF LIGHT SCATTERING [NOVYY METOD V TEORII RASSEYANIYA SVETA]
V. V. Sobolev Oct. 1966 11 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 28, 1951 p 355–362
(NASA-TT-F-10325) CFSTI: HC $1.00/MF $0.50 CSCL 20F

A tentative method for simplifying the theory of light scattering, based on the probability of light quantum yield from a given site of the medium in a given direction, is developed. The formula is applicable for calculating the energy scattered by the medium in different directions, for any position of the light source. Application examples for the formula include determination of the brightness distribution over a stellar disk, emission intensity of a stellar atmosphere, intensity distribution within a spectral line, and luminosity of a body of arbitrary shape. Generalization to a layer of finite optical thickness and arbitrary scattering indicatrix is given. Author

N67-13864# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE SECOND BOUNDARY VALUE PROBLEM OF ELECTROMAGNETIC OSCILLATIONS
R. Alimov [1966] 5 p refs Transl. into ENGLISH from Vestn. Akad. Nauk Kaz. SSR (Alma-Ata), no. 11, 1964 p 55–59

A detailed solution and proof of solution is given for a system of integral equations which involve Helmholtz functions. Electric and magnetic field intensity vectors are obtained which satisfy conditions in the domain and boundary conditions on a surface. C.T.C.

N67-13909# Brandeis Univ., Waltham, Mass.
CLASSICAL STATISTICAL MECHANICS OF THE HARD-CORE POTENTIAL
Martin J. Cooper Jun. 1966 75 p refs
(Contract Nonr-1877(04))
(AD-638830) CFSTI: HC $3.00/MF $0.75

The purpose of this work is to discuss the difficulties associated with representing the strong short ranged forces between the particles of a many-body system and to describe a method by which a more exact treatment of the N-body system becomes available without restricted domains or excluded volume regions provided that certain physical properties of the two-body scattering are retained. The method employed, that of an extended canonical point-transformation, is based on providing an equivalent nonsingular Hamiltonian which is both Hermitian and Fourier analyzable. The price of such a transformation is the introduction of non-local velocity dependent interactions between the particles. But such forms are well known in classical mechanics and can be treated in a statistical mechanical context without difficulty. This approach allows for an immediate means of analysis of the role of the hard-core interactions in a many-body system which may be treated by any of the conventional methods of statistical physics. Direct contact is made with the more usual expressions for a hard-sphere many-body system and it is explicitly demonstrated that the real advantage of this canonical reformulation of the strong interactions in terms of an equivalent momentum dependent potential lies in allowing the repulsion to be treated in the same manner as any weak long ranged interaction. Author (TAB)

N67-14034# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
THE USE OF RADIOACTIVE TRACER GASES TO STUDY THE RATE OF EXCHANGE OF WATER VAPOR BETWEEN AIR AND NATURAL SURFACES
P. J. Barry Jun. 1966 9 p refs Presented at Symp. on Isotope Tech. in the Hydrol. Cycle, Urbana, Ill., 10–12 Nov. 1965
(AECL-2576; CONF-651108-7) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Radioactive tracers have been used to measure the flux of matter at the surface of snow. By the use of two tracers having markedly different molecular diffusivities it is possible to study turbulent and molecular transports separately. The results are compared with existing evaporation equations for surface-to-air concentration gradients and none of those equations studied was found to predict rates of evaporation satisfactorily. Author (NSA)

N67-14046# Bettis Atomic Power Lab., West Mifflin, Pa.
ARRANGEMENT FOR DETECTING THE STICKING OF AN ARMATURE TO A MAGNET
Walter Lang 23 Jun. 1965 8 p Transl. into ENGLISH from German Patent No. 897782
(WARD-TRANS-34)

A magnetic-field-responsive switching element is arranged in the magnet so that it is traversed by the leakage flux when the armature is released. Means are provided to concentrate the leakage flux on the switching element, which operates a signal or control circuit. NSA

N67-14204*# Innsbruck Univ. (Austria). Inst. of Theoretical Physics.
ON THE SOLUTION OF THE HEAVY ASYMMETRIC GYROSCOPE, USING THE PROPERTIES OF THE LIE OPERATOR
F. Cap and A. Schett Nov. 1966 20 p refs
(Grant NGR-52-046-001)
(NASA-CR-80839; SR-11) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Using Lie series, the solution of the equation describing the heavy asymmetric gyroscope is presented in the forms: 1) solution = solution (heavy, symmetric) + contributions from asymmetry; 2) solution = solution (symmetric, force free) + contributions from asymmetry and forces; and 3) solution = solution (asymmetric, force free) + contributions from forces. The first term on the right side is presented in global form and the second, an integral term, can be computed by iterations. Which of the aforementioned representations is most suitable depends on the problem considered. Author

N67-14304# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
METHOD FOR THE DETERMINATION OF THE CONSTANTS OF INERTIA BY A GROUND VIBRATION TEST [METHODE DE DETERMINATION DES CONSTANTES D'INERTIE A L'AIDE D'UN ESSAI DE VIBRATION AU SOL]
Robert Kappus [1966] 11 p ref In FRENCH and ENGLISH Presented at the AGARD Meeting on Stability and Control, Cambridge, Great Britain, 20–23 Sep. 1966 Submitted for Publication
(TP-386) CFSTI: HC $1.00/MF $0.50

It is shown that the constants of inertia may be obtained without materializing any of the axes of rotation for a ground vibration test completed by the inclusion of the six 'rigid body modes' of the whole suspended system. Some details of construction and testing are given as well as the results obtained with two models, one very rigid and the other very flexible. Author (ESRO)

N67-14322# California Univ., Los Angeles. Dept. of Physics.
EXPERIMENTAL INVESTIGATION OF THE LAMBDA TRANSITION OF LIQUID HELIUM USING ACOUSTIC TECHNIQUES
Martin Bruce Barmatz (Ph.D. Thesis) Sep. 1966 112 p refs
(Contract Nonr-233(48))
(TR-25; AD-640091) CFSTI: HC $4.00/MF $0.75

The velocity and attenuation of first sound have been measured simultaneously to within microdegrees of the lambda transition of liquid helium. Measurements were made in the frequency range of 20-100 kc. With the high Q modes of the resonator, relative sound velocity measurements of one part in 100,000 could be obtained. Above the transition the velocity of sound had the temperature dependence predicted by the Pippard Theory out to 5 millidegrees from the lambda point. The velocity of sound below the transition does not agree with the Pippard Theory except within a fraction of a millidegree of the transition. The added temperature dependence beyond that expected from the Pippard theory can be fit to a series expansion in /delta T/. This additional dependence is postulated to be due to the effects of the order parameter. The minimum of the sound velocity at the lambda point was found to be finite and equal to 217.05 m/s. Using the convective properties of the resonator, the position of the density maximum was found to be approximately 6.2 millidegrees above the lambda point. Author (TAB)

N67-14337# Royal Aircraft Establishment, Farnborough (England).
PHASE FRONT DISTORTION DUE TO SOIL IRREGULARITIES [PHASENVERZERRUNG DURCH BODENINHOMOGENITAETEN]
Karl Baur Jul. 1966 17 p refs Transl. into ENGLISH from NTZ—Nachr. Tech. Z. (Brunswick), no. 8, Aug. 1957 p 385–389
(RAE-LIB-TRANS-1175) CFSTI: HC $1.00/MF $0.50

This paper is an attempt to put the selection of sites for direction finding equipment on a theoretical basis. This is done by calculating the perturbations in the advancing phase front caused

by variations in earth conductivity. A statistical estimate is made of the permissible ratios of rate of change of conductivity to conductivity, to meet the required bearing measurement accuracy of better than 1° with a probability of better than 99%. Conversely, given a site with known variations of conductivity a minimum radio frequency of operation can be specified. Author

N67-14338# Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.

PROBLEMS OF INTENSITY MEASUREMENT IN THE RAMAN EFFECT [PROBLEME DER INTENSITATSMESSUNGEN IM RAMAN-EFFEKT]

G. Schreiber Oct. 1966 8 p refs Transl. into ENGLISH from Abhandl. Akad. Wiss. Gottingen, Math.–Physik. Kl. (Gottingen), v. 6, 1964 p 57–61

(TIL/T-5657) CFSTI: HC $1.00/MF $0.50

A discussion is presented of the problems related to the influences and necessary corrections in using experimental equipment. The major problem is the temperature dependence of the Raman intensity. Other factors considered are slot geometry, sample absorption, and degree of depolarization. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N67-13353*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

X-RAY SPECTRA PRODUCED WHEN THICK SILICON TARGETS ARE BOMBARDED WITH 1.05 AND 1.25 MILLION VOLTS ELECTRONS

Jag J. Singh, Richard Adams, and Chris Gross Washington, NASA, Dec. 1966 32 p refs

(NASA-TN-D-2773) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Measurements have been made on the X-rays produced when thick silicon targets are bombarded with 1.05 MeV and 1.25 MeV electrons. The various cross sections, after correction for efficiency and finite resolution of the sodium iodide crystal for X-rays, have been compared with the predictions of the Bethe-Heitler theory. The predicted pulse height and angular distributions of the X-rays are in qualitative agreement with the measured values. However, the absolute magnitudes of the measured X-ray intensities, at both energies of the electrons, are smaller than the theoretical values (relativistic, nonscreened, and no backscattering considered). Author

N67-13355# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

PROGRAMMING THE ACCELERATING VOLTAGE AMPLITUDE OF A MODEL OF THE CIRCULAR PROTON PHASOTRON R-F SYSTEM [PROGRAMMIROVANIE AMPLITUDY USKORYAYUSHCHEGO NAPRYAZHENIYA NA MODELI VYSOKOCHASTOTNOI SISTEMY KOL'TSEVOGO PROTONNOGO FAZOTRONA]

A. A. Glazov and E. Skhvabe 1966 38 p refs In RUSSIAN Submitted for Publication

(JINR-P-2732-1)

The results of programming the accelerating voltage amplitude of the model of the circular proton phasotron r-f system are reported. By using the self-anode modulation circuit of the powerful oscillator the programming of the accelerating voltage amplitude is carried out by means of a low-powered and simple modulator. The conditions of modulation linearity considered theoretically were proved experimentally. Author

N67-13356# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON PROPERTIES OF THE CLUSTER EXPANSIONS OF THE CAUSAL S-MATRIX [O SVOISTVAKH RAZLOZHENIYA PO PUCHKAM PRICHINNOI S-MATRITSY]

L. Sh. Khodzhaev 1966 14 p refs In RUSSIAN

(JINR-P-2760)

Space-like properties of the cluster expansions of the vacuum expectation values of radiational operators as well as the matrix elements of the S-matrix are investigated in the framework of the Bogoliubov's asymptotic causal matrix theory. Author (NSA)

N67-13358# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

CONSISTENT RELATIVIZATION OF SU(6) FOR TWO-PARTICLE REACTIONS

V. I. Ogievetskii and I. V. Polubarinov 1966 6 p refs

(JINR-E-2826)

Group $SU_x(6)$ is found which is isomorphic to SU(6) and leaves free equations of motion invariant. Every particle in the reaction is transformed according to its own law. In spite of this a very simple rule obtained on how to construct invariant amplitudes. Author (NSA)

N67-13359# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

CALCULATION OF THE COEFFICIENTS OF THE MASS OPERATORS

D. Robaschik and A. Uhlmann 1966 12 p refs

(JINR-E-2771)

For normed orthogonal systems of operators the coefficients for SU(3) and SU(6) mass formulas are calculated and relations between these coefficients are considered. Author (NSA)

N67-13378# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

AN APPROXIMATE CALCULATION OF THE NEAREST POLES OF THE FUNCTIONS S'_F AND δ'_F IN CASE OF STRONG $\bar{\psi}\psi\phi$ COUPLING [PRIBLIZHENNOE VYCHISLENIE BLIZHAISHIKH POLYUSOV FUNKTSII S'_F I δ'_F V SLUCHAE SIL'NOI $\bar{\psi}\psi\phi$ SVYAZI]

A. Kyunel 1966 16 p refs In RUSSIAN

(JINR-P-2761)

Starting from the expressions for the Green functions derived in a functional formulation of quantum field theory one obtains series for the Green functions; of the scalar and spinor fields in the strong interaction of the Yukawa type. The expressions under the functional integral are expanded in a free Lagrangian. The necessary functional integrations are made in the lattice space. The ratio of the lowest mass of each field is given. Author (NSA)

N67-13380# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

ACCUMULATION OF PARTICLES IN 680-MeV SYNCHROCYCLOTRON [NAKOPLENIE CHASTITS V SINKHROTSIKLOTRONE NA 680 MeV]

V. I. Danilov, I. B. Enchevich, M. M. Kulyukin, E. A. Polferov and T. N. Tomilina 1966 15 p refs In RUSSIAN

(JINR-P-2811)

A method of beam extraction from a synchrocyclotron based on the radial oscillation excitation by an alternating field during final acceleration radii is described. The accumulation of particles was achieved by switching of accelerator current at a certain alternating magnetic field radius point. The number of accumulated particles increased linearly to 13 accumulation cycles and reached the saturation of 30 cycles. In the latter case the intensity of the accumulated beam was 14 fold higher than the intensity of single pulse and comprised 2×10^{12} r/imp. Such a method of accumulation exceeds the experimental physical efficiency of the accelerator and enlarges the scope of synchrocyclotron operation as an injector for high energy accelerators. Author (NSA)

N67-13385# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ADLER-WEISBERGER RELATION AND DISPERSION SUM RULES IN THE THEORY OF STRONG INTERACTIONS
N. N. Bogolubov, V. A. Matveev, and A. N. Tavkhelidze. 5 Aug. 1966. 10 p. refs. Submitted for Publication
(JINR-E-2876)

Assuming the unsubtracted dispersion relation for the quantity related to the divergences of the local axial currents, the Adler-Weisberger sum rule was derived for the renormalization of the axial weak constant by the strong interactions under some additional assumptions. These assumptions are as follows: the additivity principle for the scattering amplitude of the massless pseudoscalar particle on the nucleon near the threshold in the quark model and the nonrenormalization of the proper quark axial weak constant. Author (NSA)

N67-13391# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
EVALUATION OF THE APPARATUS BACKGROUND AROUND THE ADONE [STIMA DEI FONDI DI MACCHINA INTORNO AD ADONE]
M. Bernardini and S. Tazzari. 15 Apr. 1966. 10 p. refs. In ITALIAN /ts Nota Interna No. 319
(LNF-66/22)

The existing background can be divided into the background from showers generated by electrons lost by mean-life effect and background from the interactions of circulating electrons with the residual gas. The approximations made in the calculation of both background sources are given, and the calculations were reported. NSA

N67-13395# Radiation Research Associates, Inc., Fort Worth, Tex.
AN ANALYSIS OF THE PERFORMANCE OF ENCLOSURE SHIELDS IN A REAL FALLOUT FIELD Final Report
R. L. French, J. H. Price, and K. W. Tompkins. 31 Dec. 1965. 129 p. refs.
(Contract DA-23-072-AMC-332(X))
(RRA-T55; AD-637426) CFSTI: HC $4.00/MF $1.00

State-of-the-art shield calculational techniques were applied in the analysis of an experiment in which spherical and cubical multilayer iron and water enclosure shields were exposed in a real fallout field. The calculations were divided into three steps: (1) specification of the time-dependent energy spectrum of the gamma rays emitted by the fallout, (2) determination of the energy and angular distribution of the resultant gamma rays incident upon the shields, and (3) calculation of the penetration of the gamma rays into the shields. A variety of theoretical and measured data were used for the fallout emission spectra. Monte Carlo air-and ground-scattering data along with a limited amount of measured data were employed in establishing the radiation distribution incident upon the shields. Monte Carlo procedures were used to compute the penetration into the shields. Results indicated that the shields were least effective during the first few hours and that the dose transmission factors decreased by as much as 50 percent by the end of the first day. Author (TAB)

N67-13598# Polish Academy of Sciences, Cracow.
EXCITED STATES OF ^{75}As FOLLOWING THE DECAY OF ^{75}Se [STANY WZBUDZONE ^{75}As POWSTAJACE W ROZPADZIE ^{75}Se]
M. Gasior, H. Niewodniczanski, and A. Potempa. Sep. 1966. 22 p. refs. Submitted for Publication
(NP-492/PL) CFSTI: HC $1.00/MF $0.50

The conversion electron spectra from the decay of ^{75}Se and electron-electron coincidences were investigated by means of a double, iron-free, toroidal beta spectrometer. The conversion electrons accompanying gamma transitions with energy 24, 66, 81, 97, 121, 136, 199, 265, 280, 304, 401, 572, and 618 KeV were observed. The 77 KeV transition and 188 and 203 KeV transitions were not found. The conversion coefficients were determined. In order to locate the 81 KeV transition in the level scheme, the coincidence experiment was made. Author

N67-13625# Brookhaven National Lab., Upton, N. Y.
SYMMETRY PRINCIPLES IN PHYSICS
C. N. Yang (Princeton Univ.) 13 Oct. 1965. 10 p. refs. /ts Lecture Ser. No. 50
(BNL-956(T-397)) CFSTI: $1.00

A discussion is presented on symmetry principles in physics. Topics discussed are historical origins of symmetry principles; effectiveness of symmetry considerations in quantum mechanics; C, P, and T invariances; and symmetries in elementary particle physics. NSA

N67-13630# Atomics International, Canoga Park, Calif.
UNICORN: A PROGRAM TO CALCULATE POINT CROSS SECTIONS FROM RESONANCE PARAMETERS
J. M. Otter. 30 Jun. 1966. 51 p. refs.
(Contract AT(11-1)-GEN-8)
(NAA-SR-11980, Vol. VI) CFSTI: $3.00

Unbroadened cross sections for l = 0 neutrons are calculated at energy points from resonance parameters using the Breit–Wigner line shape. The interference between resonance and potential scattering for multiple resonances is properly treated. Provision is made for spin-dependent potential scattering and adjustment to 2200 m/s cross-section values. The energy grid is optimized to provide a best representation using a specified number of points for an isolated resonance. The optimization is based on a symmetric line shape and is designed for use with logarithmic interpolation in the cross section and linear interpolation in energy. Under these conditions the magnitude of the error in the integral of the cross section in each interval is a constant percentage of the total integral. A calculation of the resonance integral in up to 50 groups is provided. The UNICORN code will accommodate a maximum of 100 resonances, 100 energy points per resonance, and 3900 total energy points. The energies and cross sections may be obtained on cards and in graphical displays. The code is written in FORTRAN IV. Execution time on the IBM 7094 is about 10 millisec/resonance/point including punched cards and graphs. Author (NSA)

N67-13634# National Reactor Testing Station, Idaho Falls, Idaho.
TABULATION OF THE Pa-233 TOTAL NEUTRON CROSS SECTION DATA
F. B. Simpson and J. W. Codding, Jr. Jul. 1966. 106 p. refs.
(Contract AT(10-1)-1230)
(IN-1014) CFSTI: $4.00

The total neutron cross section for ^{233}Pa was measured from 0.01 to 10,000 ev with the Materials Testing Reactor fast chopper. These data were taken at the 20-meter flight path with a resolution of 0.08 to 2.0 μsec/meter. Difficulties arise in the analysis of these cross section data because of the growth of the ^{233}U daughter into the sample as a function of time. Because of the lack of resonance parameters for ^{233}U above 18 ev, it is difficult to extract the effect of the ^{233}U contaminant above this energy. The sample used in making these measurements was produced by irradiating 280 grams of ^{232}Th in the Engineering Test Reactor for one cycle (approximately four weeks). This produced approximately 700 mg of chemically separated ^{233}Pa in an oxide form. The sample measured approximately 25,000 R/hr at one foot. Curves and tables are presented for the total neutron cross section as a function of energy. Author (NSA)

N67-13646# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SYMMETRIC THREE-QUARK INTERACTIONS

J. Werle Jun. 1966 16 p refs
(INR-732/VII/PH) CFSTI: HC $1.00/MF $0.50

A simplified treatment of three-quark interactions is proposed. It is based on the non-relativistic three-particle Hamiltonian which is invariant under the group O_8. Such a symmetry implies that the strongest interactions between quarks are essential three-body interactions. Two-body interactions break O_8 and are responsible for the mass splitting which is two orders of magnitude smaller. The proposed O_8 symmetry simplifies considerably the discussion of energy levels. Author

N67-13863*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
INTERNAL EXCITATION IN MOLECULAR COLLISIONS
Raphael D. Levine 9 Dec. 1966 32 p refs
(Grant NsG-275)
(NASA-CR-80729; WIS-TCI-203) CFSTI: HC $2.00/MF $0.50
CSCL 20H

An analysis of molecular collisions which centers attention on internal excitation during collisions is reviewed. In the zeroth order description no energy transfer between kinetic energy of relative motion and internal energy is allowed. The evolution of the system is then analyzed as a sequence of corrections to this description. The theory thus centers attention on the migration of energy from kinetic energy of relative motion to internal excitation and back. The collision event can involve participation of states (which are stable to zero order) where the kinetic energy has been transferred into internal energy, so that the resulting motion is a bounded relative motion of internally excited collision partners. These states have only a temporary existence, as eventually energy flows back into the relative motion. Author

N67-13864*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
THE INTERNUCLEAR SEPARATION DERIVATIVES OF THE ENERGY OF A DAITOMIC MOLECULE
Hojing Kim 6 Dec. 1966 15 p
(Grant NsG-275)
(NASA-CR-80728; WIS-TCI-202) CFSTI: HC $1.00/MF $0.50
CSCL 20H

General formulae for the higher order derivatives of the energy with respect to the internuclear separation of a diatomic molecule are derived from the Hellmann–Feynman theorem and the Integral Hellmann—Feynman theorem. The phenomenon of the cancellation of terms involving the charge density and its derivatives, which has been observed for the second order derivative by Salem, is shown to prevail for third and higher order derivatives. On this basis an approximate working formula is suggested. A new condition under which an approximate wave function satisfies the Hellmann–Feynman theorem rigorously is given. With such an approximate wave function, the formulae for the general derivatives of the energy derived are also shown to be valid. Author

N67-13715# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A THREE QUARK MODEL OF BARYONIC STATES WITH NONLOCAL SEPARABLE POTENTIAL
A. Deloff Jun. 1966 35 p refs
(INR-733/VII/PH) CFSTI: HC $2.00/MF $0.50

A non-relativistic quark model of baryonic states is presented. The quarks interact via SU_3, and SU_2/spin/ invariant two and three body nonlocal separable potential. The potential states are supposed to furnish L = 0 and L = 1 /positive and negative parity/ multiplets. For the states of assumed symmetry the appropriate integral equations are derived and solved approximately in order to obtain the binding energies. In the case of the two body interaction the model provides the required, strong binding only in states $L = 1^+$, and the states L = 0 and $L = 1^-$ are not bound unless three body forces are introduced. With three body forces it is quite easy to obtain strong binding in all states considered in this paper. Author

N67-13716 Polish Academy of Sciences, Warsaw.
STUDIES ON THE EFFECTIVE NEUTRON SPECTRUM IN THE STRUCTURAL INVESTIGATIONS BY THE TIME OF FLIGHT METHOD
May 1966 13 p refs In RUSSIAN; ENGLISH summary
(INR-721/II/PS) CFSTI: HC $1.00/MF $0.50

Some experimental methods of the effective neutron spectrum determination are described. This spectrum is used in the neutron diffraction structure analysis performed by means of the time of flight method. Author

N67-13765# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
A STUDY OF (α,D) REACTION ON 40 Ca NUCLEI [REAKCJA (α,D) DLA JADER ^{40}Ca]
Jerzy Benisz, Kazimierz Grotowski, Ludwik Freindl, Waldemar Karcz, Ann Jasielska et al May 1966 16 p refs Submitted for Publication
(Rept.-478/PL) CFSTI: HC $1.00/MF $0.50

The reaction $^{40}Ca(\alpha,d)^{42}Sc$ has been studied using an α-particle beam with energy (24.7±0.1) MeV. Deuteron spectra were obtained by two independent techniques: magnetic analyzer and solid state counter telescope. Transitions to the excited states of ^{42}Sc at 0.61, 1.50, 2.18, 2.93 and 3.73 MeV and a very weak transition to the ground state have been detected. Angular distributions for transitions to the highly populated levels, 0.61 and 1.50 MeV, of final nucleus have been measured. Relative intensities of the observed transitions are discussed according to the selection rules for the two nucleon transfer reactions. Author

N67-13804# Lockheed Missiles and Space Co., Palo Alto, Calif.
SCATTERING OF KILOVOLT NEUTRONS BY LEAD AND ELECTRICAL POLARIZABILITY OF THE NEUTRON
Iu. A. Aleksandrov, G. S. Samosvat, Zh. Sereter, and Tsoi Gan Sor [1966] 5 p refs Transl. into ENGLISH of Joint Inst. for Nucl. Res Rept. No. P-2764

Polarization scattering of neutrons by lead in the energy range of up to 28 keV was measured on a pulse reactor by the transit time method. The value of the effective energy at each point was obtained by numerical integration of the resolution function, the neutron spectrum, and the energy response of the boron detectors. The intensity of neutrons scattered by a hollow lead cylinder of 10 cm diameter and a 1 cm wall thickness was measured simultaneously at all energies and values of the scattering angle between 30 and 150° were determined. Least square computations on the electrical polarizability of the neutron found a value of: $(0.3\pm9.2)\times10^{-42}$ cm^3. G.G.

N67-13814 European Organization for Nuclear Research, Geneva (Switzerland).
ORGANIZATION OF SPARK CHAMBERS WITH MAGNETOSTRICTIVE READ-OUT
G. Brautti 6 Oct. 1966 37 p refs
(CERN-66-30)

Described is the organization of a system of wire spark chambers with magnetostrictive readout for nuclear research application. The main features of the system include: ambiguity resolution for 3 tracks/chamber; automatic determination of the gravity center of several spark clusters; a maximum sum of coordinate lengths; two-spark resolution of 3 mm on each coordinate; a maximum repetition rate of 100 good events per second; on-line data rejection; analogue monitoring; and magnetic tape recording or on-line data processing. A television picture collects all events and replaces the usual optical recording. G.G.

N67-13820# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
STRUCTURE OF A BUNCH OF CHARGE IN AN IDEAL ACCELERATOR
T. D. Newton Jul. 1966 67 p refs Submitted for Publication
(AECL-2614; FSD/ING-53) CFSTI: HC $3.00/MF $0.75

A bunch of charged particles is considered to be moving in a long conducting tube subject to external time-independent focusing forces. The density of particles in the bunch and the electromagnetic field of the bunch of charge in the conducting tube are simultaneously determined. The parameters of the idealized accelerator may be obtained from those of an actual machine design so that predictions of bunch shape and effects of space and image charges on phase areas (emittances) may be made. Author

N67-13898# Polish Academy of Sciences, Warsaw.
ON THE LOWER LIMIT OF TRANSVERSE MOMENTUM AND FOUR-MOMENTUM TRANSFER OF RECOIL PROTONS IN NUCLEON–NUCLEON INTERACTIONS OF ENERGIES ABOVE 10^{12}eV
J. Babecki Jul. 1966 22 p refs Submitted for Publication
(INR-738/VI/PH) CFSTI: HC $1.00/MF $0.50

Transverse momenta and four-momentum transfers of recoil protons in nucleon–nucleon interactions of ultra high energy were determined on the basis of kinematical analysis of angular distributions of secondaries in cosmic ray jets. The method applied consisted in calculating the transverse momentum for all relativistic tracks assuming that the given track is due to a proton and in the selection of the smallest value out of all possible values of $p_\perp$. In spite of this tendency to minimize the transverse momentum a distribution of $p_\perp$ with high mean value of 1.3 GeV/c was obtained. Also in connection with this high values of four-momentum transfer were obtained of the order of a few GeV/c. An analysis of grey and black prongs was also carried out which showed that only very few of them may be tracks of recoil protons. Author

N67-13919 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
APPLICATION OF PULSED NEUTRON SOURCES TO STRUCTURE AND LATTICE DYNAMICS STUDIES OF SOLIDS [ZASTOSOWANIE IMPULSOWYCH ZRODEL NEUTRONOW DO BADAN STRUKTURY I DYNAMIKI SIECI KRYSTALICZNEJ]
Bronislaw Buras (Warsaw Univ.) Aug. 1966 26 p refs Presented at the Seminar on Intense Neutron Sources, Santa Fe, N. Mex., 19–23 Sep. 1966
(Contract IAEA-255/RB)
(INR-744/II/PS) CFSTI: HC $2.00/MF $0.50

The actual and potential applications of pulsed neutron sources to studies of structure and lattice dynamics of solids are discussed. A brief description of the time-of-flight /TOF/ method for structure analysis is given, some typical results obtained both for powders and single crystals are presented, and a comparison between the conventional and TOF methods is made. Special emphasis is put on resolution and intensity /time of exposure/ problems. In particular it is shown that for magnetic structure analysis and small lattice distortions studies the TOF method used with repetitively pulsed reactors is preferable. Special features of the TOF method and their nonconventional applications to structure studies are discussed. A new modification of the TOF method for lattice dynamics research, is briefly presented. Special features of the TOF method and their nonconventional applications to lattice dynamics studies are mentioned. A method for simultaneous structure and lattice dynamics studies is presented. Author

N67-13954# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
ATOMISTICS AND THE DIVISIBILITY OF SPACE AND TIME
Hideki Yukawa Sep. 1966 22 p refs Submitted for Publication
(RIFP-55) CFSTI: HC $1.00/MF $0.50

Skepticism is voiced about straight-forward applications of quantum field theory to subnuclear phenomena, and a point of view is presented that can be regarded as an extension of atomistics to the part of space that is not occupied by particles as well as a new version of the theory of ether with globular structure. The present theory differs from previously developed nonlocal field theories in that there is the concept of the empty seat. Therefore, the ground state can not be erased since it is an empty seat itself. To deal with the case of arbitrary numbers of particles, it is necessary to imagine in advance the totality of seats that the particles can occupy. Elementary domains and elementary particles are treated in detail, and modifications of the mathematical models are included. M.W.R.

N67-13955# Warsaw Univ. (Poland). Dept. of Radiochemistry.
NEUTRINOS IN SUPERDENSE MATTER. IV: MASSIVE NEUTRINOS IN A PERFECT FLUID SPHERE
Bronislaw Kuchowicz Apr. 1966 11 p refs
CFSTI: HC $1.00/MF $0.50

The study of neutrino motion in superdense matter bulks is extended to neutrinos of a non-zero rest mass. The results do not introduce any essential change to the picture of neutrino motion which has been obtained by the present author and has been presented in preceding reports of this series. Author

N67-13964# Massachusetts Inst. of Tech., Cambridge.
GENERALIZED HARTREE–FOCK CALCULATION FOR ZR-90 USING AN EFFECTIVE INTERACTION
Y. R. Waghmare, C. M. Shakin, and J. P. Svenne 22 Jul. 1966 9 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., Sep. 1966 Submitted for Publication
(Contract AT(30-1)-2098)
(CONF-660906-6; MIT-2098-255) CFSTI: HC $1.00/MF $0.50

Hartree–Fock calculations have been performed for ^{90}Zr using an effective interaction derived from the Yale potential. Results are presented for the binding energy, r.m.s. radius, and single-particle energies. Comparison is made with similar calculations using the nonlocal Tabakin potential. Author (NSA)

N67-13965# Los Alamos Scientific Lab., N. Mex.
A HIGH-RESOLUTION STUDY OF INELASTIC PROTON SCATTERING FROM NUCLEI IN THE Pb REGION: THE 2.6 MeV OCTUPOLE STATE
J. C. Hafele and Richard Woods [1966] 8 p refs Presented at Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., 12–17 Sep. 1966
(Contract W-7405-ENG-36)
(CONF-660906-10; LA-DC-8069) CFSTI: HC $1.00/MF $0.50

The magnetic analysis of 21-MeV protons inelastically scattered from the 2.6-MeV octupole state of ^{206}Pb, ^{207}Pb, ^{208}Pb, and ^{209}Bi is reported. In the odd-A nuclei, this state splits into a close multiplet with the number of levels in agreement with the predictions of the weak-coupling model. Energies and spins for the multiplet levels are assigned, and multipole strengths for the interaction are derived. Author (NSA)

N67-13966# Los Alamos Scientific Lab., N. Mex.
A COMPARISON OF ROTATIONAL M1 TRANSITION RATES BETWEEN HIGH AND LOW SPIN STATES
G. G. Seaman, E. M. Bernstein, and J. M. Palms [1966] 9 p refs Presented at Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn. Submitted for Publication
(Contract W-7405-ENG-36)
(CONF-660906-11; LA-DC-8061) CFSTI: HC $1.00/MF $0.50

Measurements were made of branching ratios from rotational states in ^{153}Eu, ^{159}Tb, ^{165}Ho, ^{169}Tm, ^{171}Yb, ^{173}Yb, ^{175}Lu, and ^{181}Ta populated by multiple Coulomb excitation with oxygen ions. The relative B(M1) values calculated from these ratios are in good agreement in all cases with the collective model. Author (NSA)

N67-13987# Hamburg Univ. (West Germany).
REPORT ABOUT SOME INVESTIGATIONS IN LOW ENERGY PHYSICS PERFORMED IN JAPAN [BERICHT UEBER EINIGE ARBEITEN AUF DEM GEBIET DER NIEDERENERGIE-KERNPHYSIK ANLAESSLICH EINES STUDIENAUFENTHALTES IN JAPAN]
G. Breuer Jun. 1966 50 p refs In GERMAN
(BMWF-FBK-66-15)

Separate abstracts were prepared for 3 of the 4 sections presented. One section on the construction of a ^{3}He gas circuit for induced ^{3}He reactions with cyclotrons was not abstracted for NSA. NSA

N67-13989# Atomic Energy Information Service, Frankfurt Am Main (West Germany).
BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 06: INSTRUMENTS AND MEASURING TECHNIQUES IN NUCLEAR PHYSICS [BIBLIOGRAPHIEN ZUR KERNFORSCHUNG UND KERNTECHNIK. SEKTION 06: MESSINSTRUMENTE UND MESSVERFAHRENEN IN DER KERNPHYSIK]
K. Debertin, comp. May 1966 196 p refs In GERMAN
(AED-C-06-14)

Bibliographies are presented on instruments and techniques in nuclear physics. Also included are report number, patent, author, and subject indexes. NSA

N67-13970# Brookhaven National Lab., Upton, N. Y.
ENGINEERING PROBLEMS IN PULSED NEUTRON SOURCES
K. C. Hoffman, R. Parsick, M. Reich, and M. Levine Aug. 1966 21 p refs Presented at Seminar on Intense Neutron Sources, Los Alamos, N. Mex. Submitted for Publication
(Contract AT(30-2)-GEN-16)
(CONF-660914-1; BNL-10454) CFSTI: HC $1.00/MF $0.50

Design studies were made for two high-performance repetitively pulsed neutron sources: an advanced pulsed fast reactor, and an advanced accelerator-booster system. The major engineering problems associated with each type of device, a description of the method of analysis, and a summary of the analytical results are discussed. The advanced pulsed reactor studied has an average power of 30 MW in a 20 liter core producing 1.1 MW-sec bursts of energy with a repetition rate of 22 bursts/sec. The total leakage neutron yield per burst is 6×10^{16} with a burst width at half power of 60 μsec. The advanced booster concept has an average power of 9 MW in a 6 liter core producing 160 bursts per second with .044 MW sec of energy in each burst. The core assembly has a prompt multiplication of 250 and is driven by an electron accelerator that develops a 33 amp average current of 30 MeV electrons for 3 microseconds. The total leakage neutron yield is 2×10^{15} per burst with a burst width at half power of 6.5 μsec. Thermal, hydraulic, mechanical, and physics analyses of both systems are presented. The major engineering problems are encountered in the fuel elements and in the rotating assemblies containing fuel and reflector pieces for reactivity pulsing. Performance requirements for these components are evaluated and discussed. Author (NSA)

N67-13987# Junta de Energia Nuclear, Madrid (Spain). Div. de Fisica.
FREE FIELDS FOR NEUTRINOS AND PHOTONS [CAMPOS LIBRES DEL NEUTRINO Y DEL FOTON]
Rafael Núñez-Lagos Roglá (Ph.D. Thesis) 1966 148 p refs In SPANISH
(JEN-157-DF/I-48)

A relativistic quantum field theory is presented in a general and intrinsic way. The building blocks are the one particle states and the unitary representations of the Lorentz group. From these, different useful many-particle states and applications to relate them are defined. One particle operators are extended to the field spaces. Annihilation and creation operators are introduced in a natural way, their algebra being fixed by the microscopic causality. The theory is applied to the spin 1/2 case, and different realizations for the neutrino and antineutrino fields are obtained and analyzed. The spin 1 case follows as a consequence of the fusion method, and Maxwell equations and Lorentz and Gauge conditions are easily deduced. There are no difficulties related to the metric and the local commutation rules. Author (NSA)

N67-13991# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
MEASUREMENTS OF THE NEUTRON DIFFUSION PARAMETERS OF THE ORGANIC GLASS BY MEANS OF THE CHOPPER METHOD
A. Graffstein, Z. Ogrzewalski, T. Rzeszot, A. Stanolow, and E. Warda Feb. 1966 10 p refs
(INR-690/IX-A/R)

The neutron diffusion parameters of the organic glass were measured by means of the pulsed method using the chopper as a pulsed neutron source. The experimental dependence of the decay constant of the thermal neutron flux as a function of buckling of examined sample was fitted to a power series in B^2 by the method of weighted least squares. Two fits were tried using series which terminated with the B^4 and B^6 terms. Calculations were performed for constant extrapolation length d=0.34 cm and buckling dependent extrapolation length $d=d(B^2)$. Author (NSA)

N67-14001# Oak Ridge National Lab., Tenn. Isotopes Development Center.
REVIEW OF ORNL ELECTROMAGNETIC SEPARATIONS PROGRAM, 1965
L. O. Love and W. A. Bell Aug. 1966 37 p refs
(Contract W-7405-ENG-26)
(ORNL-4006) CFSTI: HC $2.00/MF $0.50

The effort in the electromagnetic separations program was divided between separating materials for requirements and developing techniques and equipment needed for the separations program to keep pace with stated or anticipated requirements in quantity and isotopic purity of product samples. In >60% of the separations completed this year, operations improved in one or more of the parameters used in judging separation performance. The first major electromagnetic separation of beta-gamma material was completed in the heavy-element section of the program. Ion sources, isotope receivers, ion implantation, contamination studies, vacuum improvement, developments incorporated into scheduled separations, 180° sector separator development, heavy-element separations, and stable isotope separations are discussed. NSA

N67-14006# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CONFIGURATION MIXING IN QUARK MODEL SMESHIVANIE KONFIGURATSII V MODELI KVARKOV]
V. A. Matveev, B. V. Struminskii, and V. G. Targamadze 1966 8 p refs In RUSSIAN
(JINR-P-2821)

The magnetic moments and the axial constants are obtained in the assumption of the configuration mixing in the quark model. The obtained results are in good agreement with experiment. Author (NSA)

N67-14007# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
METHOD OF PHASE FUNCTIONS IN QUANTUM MECHANICS [METHOD FAZOVYKH FUNKTSII V KVANTOVOI MEKHANIKE]
V. V. Babikov 1966 30 p refs In RUSSIAN Submitted for Publication
(JINR-P-2758)

A brief review is given of a method for solving the problems of quantum mechanics in nuclear and atomic physics, which is widely developed of late. The method of phase functions proved to be very convenient in practical calculations as well as in a number of general problems of quantum mechanics. Author (NSA)

N67-14009# California Univ., Berkeley. Lawrence Radiation Lab.
SIGN OF THE K_1^0–K_2^0 MASS DIFFERENCE
Gerald Warren Meisner (Ph.D. Thesis) 22 Jul. 1966 51 p refs
(Contract W-7405-ENG-48)
(UCRL-17007) CFSTI: HC $3.00/MF $0.50

An experiment was performed to measure the sign of m_1–m_2 by following the time development of $K_{neutral}$-p elastic scatters. The K_2^0 was found to be heavier than K_1^0. The statistical confidence level depended on the unresolved Fermi–Yang-type (F–Y) ambiguity that exists at present in the KN (strangeness S = +1) phase shifts in isotopic-spin state I = 0. If the F solution (large positive $p_{3/2}$ phase shift) is correct, the Monte Carlo betting odds of 45 to 1 for $m_2 > m_1$ are obtained, assuming $|m_1-m_2| = 0.57\tau_1^{-1}$. If instead the Y solution (large positive $p_{1/2}$ phase shift) is correct, the betting odds for $m_2 > m_1$ are 5 to 1. The F–Y ambiguity was not resolved. Author (NSA)

N67-14010# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
EXISTENCE OF CERTAIN BARYON AND MESON UNITARY MULTIPLETS [O SUSHCHESTVOVANII NEKOTORYKH BARIONNYKH I MEZONNYKH UNITARNYKH MUL'TIPLETOV]
L. Enkovskii, V. V. Kukhtin, and Nguyen Thi Hong 1966 10 p refs In RUSSIAN Submitted for Publication
(JINR-P-2790)

The existence of unitary octets, decuplets, and singlets of baryon resonances with spin and parity $5/2^+$, $7/2^+$, and $1/2^-$ respectively, and meson resonance nonet 1 was investigated. The ratio of the probability of decay of the following types: $5/2^+ \to 1/2^+ + 0$, $7/2^+ \to 1/2^+ + 0$, $1/2^- \to 1/2^+ + 0$, and $1^+ \to 0^- + \gamma$ was found. Author (NSA)

N67-14011# California Univ., Berkeley. Lawrence Radiation Lab.
STUDY OF THE REACTION $\eta \to \pi^+\pi^-\gamma$
Le Roy Raymond Price (Ph.D. Thesis) 8 Jun. 1966 42 p refs
(Contract W-7405-ENG-48)
(UCRL-16923) CFSTI: HC $2.00/MF $0.50

The results of an analysis of 33 decays of the type $\eta \to \pi^+\pi^-\gamma$ are presented. It is found that the rho-dominant model fits the data quite well. No conclusions can be drawn regarding the possible existence of a C-nonconserving interaction. Author (NSA)

N67-14012# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
SPIN CORRELATION IN ELASTIC SCATTERING OF 605-MeV POLARIZED PROTONS ON PROTONS [SPINOVAYA KORRELYATSIYA PRI UPRUGOM RASSEYANII POLYARIZOVANNYKH PROTONOV S ENERGIEI 605 MeV NA PROTONAKH]
B. M. Golovin, R. Ya. Zul'karneev, V. S. Kiselev, S. V. Medved, V. I. Nikanorov et al 1966 8 p refs In RUSSIAN Submitted for Publication
(JINR-P-277C)

Spin correlation coefficients for elastic p–p scattering were measured at the angle of 90°cms. A polarized 605 MeV proton beam was used in the experiment. The measurements were made with spark chambers controlled by scintillation counters. The following coefficient values were found to be $C_{nn} = 0.56 \pm 0.18$; $C_{kp} = 0.27 \pm 0.18$; $C_{qkn} = 0.92 \pm 0.38$. Author (NSA)

N67-14013# California Univ., Berkeley. Lawrence Radiation Lab.
ANALYSIS OF STRANGE-PARTICLE RESONANT STATES FROM π^-p INTERACTIONS
Lyndon Mauriece Hardy (Ph.D. Thesis) 11 Jul. 1966 103 p refs
(Contract W-7405-ENG-48)
(UCRL-16788) CFSTI: HC $4.00/MF $0.75

An analysis is presented of π^-p interactions producing strange-particle final states with an incident laboratory momentum ranging from 1.6 to 4.2 BeV/c. These final states were found to be dominated by the production of well-established resonant states. No evidence was seen for the existence of new resonant phenomena. The reactions $\pi^-p \to Y^0K^{*0}$ and $\pi^-p \to Y^{0*}K^0$ proceed peripherally. Simple one-particle exchange does not describe the processes $\pi^-p \to \Sigma^0K^{*0}$ and $\pi^-p \to \Delta K^{*0}$. The absorption model gives an adequate fit to the data for these reactions and indicates the dominance of K^* exchange over K exchange. Author (NSA)

N67-14014# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ON THE DECAY OF NEUTRAL PIONS INTO THREE PHOTONS [O RASPADE NEITRAL'NYKH PIONOV NA TRI FOTONA]
A. V. Tarasov 1966 8 p refs In RUSSIAN Submitted for Publication
(JINR-P-2763)

The process $\pi^0 \to 3\gamma$ is considered. The general form of the amplitude is determined. The probability ratio is shown to be $[W(\pi^0 \to 3\gamma)/W(\pi^0 \to 2\gamma)] \leq 10^{-9}$ Author (NSA)

N67-14015# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
INELASTIC π^-p-INTERACTIONS AT ENERGY 7.5 GeV. PART II: FOUR-PRONG EVENTS WITH PROTONS [NEUPRUGIE π^-p VZAIMODEISTVIYA PRI ENERGII 7.5 GeV. CHAST II: 4-LUCHEVYE SOBYTIYA S PROTONAMI]
E. Balya, O. Balya, V. A. Belyakov, E. N. Kladnitskaya, E. S. Kuznetsova et al 1966 32 p refs In RUSSIAN Submitted for Publication
(JINR-P-2773)

729 events of the reaction $\pi^-p \to p\pi^+\pi^-\pi^-m\pi^0 (m \geq 0)$ at 7.5 BeV were analyzed on the photographs of 24-liter JINR propane bubble chamber. The cross section 5.1 ± 0.3 mb of analyzed reactions is obtained. The angular and momentum distributions of p, π^+, π^--particles are investigated. Production of meson and baryon resonant states are studied, particularly $N_{3,3}^{*++}$, $N_{3,3}^{*0}$ and ρ^0-meson are observed. Author (NSA)

N67-14021# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
THE DECAY OF ^{152}Tb [ISSLEDOVANIE IZLUCHENIYA ^{152}Tb]

K. Vil'skii, K. Ya. Gromov, M. Iorgensen, V. V. Kuznetsov, M. Ya. Kuznetova et al 26 May 1966 26 p refs In RUSSIAN Submitted for Publication
(JINR-P-2762)

The decay scheme of ^{152}Tb was investigated by measuring e^--γ and β^+-γ coincidence spectra and conversion-electron spectra. Many previously unreported levels of ^{152}Gd were identified, and spin–parity assignments were made. Branching ratios were also determined. NSA

N67-14022# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
SOME ASPECTS OF THE MULTI-NUCLEON TRANSFER REACTION MECHANISM [NEKOTORYE OSOBENNOSTI MEKHANIZMA REAKTSII MNOGONUKLONNYKH PEREDACH]
Ya. Vil'chinski, V. V. Volkov, and P. Detsovski 1966 12 p refs In RUSSIAN
(JINR-P-2813)

The reaction ^{27}Al(^{14}N,^{18}F)^{23}Na was investigated at 65.0, 78.7, 91.4, and 107.3 MeV. The energy distributions of the ^{18}F reaction products were measured at different angles. In addition to the products of the transfer reaction ^{27}Al(^{14}N, ^{18}F)^{23}Na, ^{17,2} nuclei of significantly lower energy were observed in the energy distributions. An interpretation of the results in terms of two different mechanisms of the ^{27}Al(^{14}N,^{18}F)^{23}Na reaction is proposed. NSA

N67-14023# California Univ., Livermore. Lawrence Radiation Lab.
HIGH-RESOLUTION STUDIES OF FISSION X-RAYS AND GAMMA RAYS
W. John, D. H. White, B. G. Saunders, R. W. Jewell, and D. Groves 12 Aug. 1966 10 p refs Presented at 3d Circ. Intern. Symp., Lysekil, Sweden, 21–27 Aug. 1965 Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-70045) CFSTI: HC $1.00/MF $0.50

The spectra of gamma rays and X-radiation from fission products were investigated using a bent-crystal spectrometer in three different arrangements. The source consisted of an Al-^{235}U foil exposed to a neutron flux from a pool-type reactor. Line intensities were determined, and the time of dependence of the radiation was studied. NSA

N67-14044# California Univ., Berkeley. Lawrence Radiation Lab.
APPROXIMATIONS IN THE THEORY OF REARRANGEMENT COLLISIONS AND APPLICATIONS TO A TRACTABLE MODEL OF CHARGE EXCHANGE SCATTERING
James Quong (Ph.D. Thesis) 19 Aug. 1966 79 p refs
(Contract W-7405-ENG-48)
(UCRL-17034) CFSTI: HC $3.00/MF $0.75

The approximation ideas and methods and the historic difficulties involved with the calculation of ion–atom rearrangement scattering are examined and redeveloped. Five approximation schemes are selected to be tested. The transition probability for symmetric resonant charge exchange is calculated by these methods for a model one-dimensional scattering system whose exact solution, serving as the basis for comparison, is also attainable by numerical techniques. The impact parameter ideas concerning the uncoupling of the internal and external dynamics are built into the model. An exchange mechanism is found to be operative for all energies up through the intermediate range. The two two-component coupled-channel schemes, one employing atomic form factors, the other molecular form factors, together cover accurately this span of the spectrum. At decreasing energies, the mechanism of the adiabatic approximation, tending to suppress exchange in nonresonant systems, becomes progressively more important and eventually becomes decisive. The formal statement is that the coupled-channel schemes provide an adequate theory for calculating the exchange probability, within the limitation imposed by off-manifold processes, over the low and intermediate ranges of energy for all three types of scattering systems. Author (NSA)

N67-14049# Oak Ridge National Lab. Tenn.
ELECTRON SPIN RESONANCE SPECTRA OF Dy^{3+} IN ThO_2 AND CeO_2
M. M. Abraham, C. B. Finch, L. J. Raubenheimer, Z. M. El Saffar, and R. A. Weeks Aug. 1966 11 p refs Presented at the Intern. Conf. on Magnetic Resonance and Relaxation, 14th Collog. AMPERE, Ljubljana, Yugoslavia
(Contract W-7405-ENG-26)
(ORNL-P-2466; CONF-660924-1) CFSTI: HC $1.00/MF $0.50

Single crystals of ThO_2 and CeO_2 (fluorite structure) doped with 0.5 atomic weight percent impurities of isotopically enriched Dy^{3+} (94% even–even isotopes) were grown. Electron spin resonance (ESR) measurements at $\simeq$10 Gcps and liquid helium temperatures reveal spectra with symmetry axes along the 4 crystal [111] axes. For ThO_2 $g_\parallel$ = 1.625±0.002, $g_\perp$ = 9.95±0.05 and for CeO_2 $g_\parallel$ = 1.632± 0.002, $g_\perp$ = 9.98±0.05. An additional line is observed and attributed to a $|1/2> \rightarrow |-1/2>$ transition between the levels of a ground state Γ_8 quartet in a cubic crystal field. For ThO_2, $g_{[100]}$ = 4.566, $g_{[111]}$ = 4.323, $g_{[110]}$ = 4.386, and for CeO_2 $g_{[100]}$ = 4.433, $g_{[111]}$ = 4.401, $g_{[110]}$ = 4.411 with 0.1% error. These data are sufficient for a calculation of the ratio of the cubic crystal field 4th and 6th order parameters. At 20° K no spectra were observed, which made it possible to detect a low lying Γ_7 doublet as observed in the case of the isomorphous CaF_2. All line widths were larger than those for other rare-earth ions in these crystals and were 20 to 40 gauss. Author (NSA)

N67-14050# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
THE STRUCTURE OF THE GROUND AND EXCITED STATES OF DEFORMED ODD-MASS NUCLEI IN THE ACTINIDE REGION
L. A. Malov and V. G. Solov'ev 1966 14 p refs
(JINR-E-2857)

The interaction of quasi-particles with quadrupole and octupole phonons in deformed odd-mass nuclei in the actinide region is calculated in the framework of the method of approximate second quantization. This interaction leads to the formation of low-lying collective non-rotational states and complex-structure states. Beta-vibrational and octupole phonons are more important in the actinide region than in the rare-earth one. Good agreement with experimental data was obtained. Author (NSA)

N67-14051# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ON MECHANISM OF THE PROTON TRANSFER REACTIONS
V. V. Volkov and Ya. Vil'chinski 1966 18 p refs Submitted for Publication
(JINR-E-2824)

The proton transfer reaction (^{12}C, ^{13}N) on ^{12}C, ^{27}Al, ^{51}V, ^{93}Nb, ^{107,109}Ag, and ^{181}Ta target nuclei was investigated. The angular distributions at different energies, well above the Coulomb barrier, were measured. Distinct differences between the neutron and proton transfer reactions were revealed. The proton transfer cross section rapidly reduces with the increasing atomic number of

the target. Moreover, the excitation functions decrease faster with decreasing energy than in the case of neutron transfer. The analysis of the experimental data, based on the single nucleon transfer reaction models of Frahn and Venter, and Kalinkin and Grabowski shows these differences. The observed specific behavior of the proton transfer reactions may be due to the Coulomb polarization of the proton wave functions. Author (NSA)

N67-14062# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.

KeV NEUTRON SCATTERING BY LEAD AND ELECTRICAL POLARIZABILITY OF NEUTRON [RASSEYANIE KILOVOL' TNYKH NEITRONOV SVINTSOM I ELEKTRICHESKAYA POLYARIZUEMOST NEITRONA]

Yu. A. Aleksandrov, G. S. Samosvat, Zh. Sereter, and Choy Gen Sor 1966 8 p refs In RUSSIAN
(JINR-P-2764)

The angular distributions of neutrons scattered by lead at energies up to 25 kev were measured at angles of 30 to 150°. An analysis of the results shows that the magnitude of the electric polarizability coefficient of the neutron (α_n) is within the limits $-4.7\times10^{-42}\text{cm}^3<\alpha_n<6.1\times10^{-42}\text{cm}^3$. NSA

N67-14063# International Centre for Theoretical Physics, Trieste (Italy).

DEGENERATE REPRESENTATIONS OF THE SYMPLECTIC GROUPS. I: THE COMPACT GROUP Sp(n)

P. Pajas and R. Raczka Jun. 1966 48 p refs
(IC-66/77)

The theory of the degenerate representations of the rotation and unitary groups is extended to unitary symplectic groups, i.e., those which conserve symmetric and antisymmetric bilinear forms. NSA

N67-14064# International Centre for Theoretical Physics, Trieste (Italy).

A REFINED SOLUTION OF TWO-DIMENSIONAL MODEL THEORIES

F. Schwabl, W. Thirring, and J. Wess Aug. 1966 27 p refs
(IC-66/96)

In the formulation of the model, special care was given to the definition of the current as the product of field operators. It it shown that a product of field operators, where the space-time points coincide, can be defined as the limit of products with the points separated and that the limit exists in the Borchers topology. A consistent definition of the current can be given this way, and the model where a massive vector field is coupled to this current is solved through an ansatz. The interacting fields can be expressed in terms of free canonical quantities. To avoid infrared divergences, a finite volume is used. Author (NSA)

N67-14066# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

DISPERSION SUM RULES FOR STRONG AND ELECTROMAGNETIC INTERACTIONS

V. A. Matveev, V. G. Pisarenko, and B. V. Struminskii 1 Jul. 1966 8 p refs
(JINR-E-2822)

Dispersion sum rules for strong and electromagnetic interactions of nucleons are considered. In the resonance approximation the relations between coupling constants and magnetic moments of nucleons are obtained. The results are in good agreement with the experiment. Author (NSA)

N67-14067# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

RECOIL PROTON POLARIZATION IN ELASTIC π^-p SCATTERING AT 300 MeV AND THE PHASE SHIFT ANALYSIS OF PION–NUCLEON SCATTERING

I. M. Vasilevskii, V. V. Vishnyakov, I. M. Ivanchenko, L. I. Lapidus, I. N. Silin et al 2 Aug. 1966 8 p refs
(JINR-E-2860)

New measurements of recoil proton polarization in 300 MeV π^--p-scattering have been carried out. The phase shift analysis of all available data on π-N interactions at 310 MeV was performed. A Geiger counter hodoscope with controlled pulse supply was used for measurements. The asymmetry of recoil proton scattering on carbon was detected with a spark chamber. The SPDF analysis was made. The experimental data are described which is similar to that of Vik and Rugge. Author (NSA)

N67-14068# Massachusetts Inst. of Tech., Cambridge. Lab. of Nuclear Science.

SEARCH FOR FRACTIONALLY CHARGED, WEAKLY INTERACTING PARTICLES

J. Foss, D. Garelick, S. Homma, W. Lobar, L. S. Osborne et al 1 Sep. 1966 2 p Presented at 13th Intern. Conf. on High Energy Phys., Berkeley, Calif., 31 Aug.–7 Sep. 1966
(Contract AT(30-1)-2098)
(MIT-2098-264; CONF-660808-10) CFSTI: HC $1.00/MF $0.50

Characteristics of an experiment for photon-produced weakly-interacting fractionally-charged particles are discussed. NSA

N67-14069# Massachusetts Inst. of Tech., Cambridge. Lab. of Nuclear Science.

π^0 PHOTOPRODUCTION AT 3.0, 4.0, AND 5.0 GeV FOR BARYON FOUR MOMENTUM TRANSFERS BETWEEN 0.5 AND 0.4 (GeV/c)^2

G. C. Bolon, D. Garelick, S. Homma, D. Luckey, R. Lewis et al 1 Sep. 1966 13 p refs Presented at 13th Intern. Conf. on High Energy Phys., Berkeley, Calif., 31 Aug.–7 Sep. 1966
(Contract AT(30-1)-2098)
(MIT-2098-265; CONF-660808-9) CFSTI: HC $1.00/MF $0.50

Preliminary results of measurements of the cross sections for the reaction $\gamma + p \rightarrow \pi^0 + p$ are reported. From the energy variations of the cross sections and the dip at momentum transfer of -0.8 it is suggested that the ρ is important in meson (π^0) photoproduction. NSA

N67-14070# Maryland Univ., College Park. Dept. of Physics and Astronomy.

INVESTIGATIONS ON THE PROPERTIES OF K MESONS AND HYPERONS AND RELATED TOPICS IN HIGH ENERGY PHYSICS

G. A. Snow Aug. 1966 24 p refs
(Contract AT(40-1)-2504)
(ORO-2504-96; TR-614) CFSTI: HC $1.00/MF $0.50

A progress report is presented on bubble and spark chamber experiments with mesons (K) at the University of Maryland. Also included are summaries of theoretical work in progress such as baryon–baryon reactions and SU(3) symmetry, determination of NΛK coupling constant from KN dispersion, $\pi\pi$ effective mass anomaly in low energy π^- p $\rightarrow$ $\pi^+\pi^-$n and the Olsson-Yodh model, reaction predictions of higher symmetries, assignment of Y$_1^*$(1765) and Y$_0^*$(1520) into the 1134 representation of SU(8), and nonlinear density effect in the transmission of K^0-mesons through matter. NSA

N67-14071# Deutsches Elektronen-Sychrotron, Hamburg (West Germany).

CURRENT COMMUTATION RELATIONS IN THE FRAMEWORK OF GENERAL QUANTUM FIELD THEORY

B. Schroer and P. Stichel (Hamburg Univ.) Jul. 1966 38 p refs Revised

(DESY-66-/19)

A rigorous formulation of Gell-Mann's equal time commutation relations in the framework of general quantum field theory is presented. It is shown that this can be achieved despite the nonexistence of charge operators for nonconserved currents. Starting from the properly formulated equal time commutation relations of generalized charges, the application of the Gauss-Theorem is justified and the limits for large times of time dependent generalized charges are discussed. The Jost-Lehmann-Dyson representation is used in order to show that the equal time commutation relations always lead to exactly one frame independent sum rule. The connection between properties of the Jost-Lehmann-Dyson spectral function and the convergence of Adler-Weisberger type sum rules is also discussed. Author (NSA)

N67-14072# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

INTERPRETATION OF PARAFIELD AS AN USUAL FIELD WITH AN INNER DEGREE OF FREEDOM [INTERPRETATSIYA PARAPOLYA KAK OBYCHNOGO POLYA S VNUTRENNEI STEPEN'YU SVOBODY]

A. B. Govorkov 1966 12 p refs In RUSSIAN

(JINR-P-2756)

Paraquantization is another form of writing the fact that usual fermion and boson fields have an inner degree of freedom. Author (NSA)

N67-14073# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

MATRIX ELEMENTS OF LORENTZ TRANSFORMATION FOR UNITARY CONCEPT [MATRICHNYE ELEMENTY PREOBRAZOVANIYA LORENTSA DLYA UNITARNOGO PREDSTAVLENIYA]

Tao Wong Tak and Nguyen Van Hieu 1966 7 p refs In RUSSIAN Submitted for Publication

(JINR-P-2777)

An expression was derived for the matrix elements of Lorentz transformation in the case of unitary (infinite) concept. The expression was based on the canonical concept executed in the Hilbert space $L_2(z)$. Author (TAB)

N67-14074# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

REDUCTION OF THE ENERGY SPECTRA ON NON-STABLE PARTICLES ACCORDING TO THEIR DECAY [VOSSTANOVLENIE ENERGETICHESKOGO SPEKTRA NESTABIL'NYKH CHASTITS PO IKH RASPADAM]

G. I. Kopylov 1966 20 p refs In RUSSIAN Submitted for Publication

(JINR-P-2797)

If the direction and magnitude of the momentum of only part of the decay products of unstable particles are measured, then this is sufficient for the determination of the energy of the particle if the direction is known. However the energy spectrum of unstable particles can be reduced from the integral equation relating the characteristics of the primary and secondary particles. It was shown that the equations appear especially simple if the particle motion characterizes either their longitudinal speed or the sum (difference) of their energies and longitudinal momentum. The kernel of the equation for the most important cases was described, and their solutions were reduced. Author (NSA)

N67-14075# Sandia Corp., Albuquerque, N. Mex.

RANGE AND TOTAL IONIZATION OF LOW-ENERGY RECOIL IONS FROM α DISINTEGRATIONS IN PURE AND BINARY GASES

G. L. Cano Jul. 1966 10 p Presented at Am. Phys. Soc. Meeting, Mexico City

(Contract AT(29-1)-789)

(SC-DC-66-1564; CONF-660811-1) CFSTI: HC $1.00/MF $0.50

Energy and range loss measurements were made for the $^{210}Po(\alpha)^{206}Pb$ reaction in argon gas. The 5.3-MeV α particles were used primarily for calibration purposes. The ^{206}Pb recoil particle nascent velocity was $V = 0.142\ V_0$. The kinetic energy in the center-of-mass system between the ^{206}Pb particle and Ar gas atoms initially was 16.8 keV. The range and average energy loss per ion pair produced by the slow, heavy Pb recoil particle was determined as a function of the gas. Results are presented for Ar, Ar + C_2H_4, C_2H_4, N_2, and $N_2 + C_2H_4$. NSA

N67-14080# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

RADIATIVE CORRECTIONS TO BREMSSTRAHLUNG AND PAIR PRODUCTION AT HIGH ENERGIES [STRAHLUNGSKORREKTUREN ZU BREMSSTRAHLUNG UND PAARERZEUGUNG BEI HOHEN ENERGIEN]

Hans Dietrich Schulz Jun. 1966 105 p refs In GERMAN; ENGLISH Summary

(DESY-66/16)

Radiative corrections to bremsstrahlung should show up in a precision measurement of the bremsstrahlung spectrum as deviations from first-order cross sections. If this measurement is done with a pair spectrometer, radiative corrections to pair production will contribute as well. The results of such a measurement are presented. Theoretical cross sections for bremsstrahlung and pair production at high energies are discussed, including Coulomb correction, effects of the atomic electrons, and second-order effects (radiative corrections). It is shown that at high energies and with high-Z target nuclei the various approximations made in deducing the first order cross sections plus Coulomb correction contribute an error of less than 0.5% to the cross section integrated over all angles, whereas neglect of radiative corrections causes errors of up to 4%. A description of the experimental setup and procedure is given. Experimental conditions were chosen in such a way that pure thin-target spectra integrated over the emission angles of photons were measured. Experimental results are compared to theoretical predictions, and possible systematic errors are discussed. Deviations from first-order cross sections plus Coulomb correction are observed which are distinctly outside the error limit of 1% recalculated by the method of Mork and Olsen, taking into account the special experimental conditions. Radiative corrections amount to +2.5% for relative photon energies below $k/E_0 = 0.9$ and drop to −3% at $k/E_0 = 0.99$. Roughly one fifth of the correction stems from the bremsstrahlung process and four fifths from pair production. Author (NSA)

N67-14088# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

HELIUM-8 PRODUCTION IN NEGATIVE PION CAPTURE BY CARBON AND OXYGEN NUCLEI

Yu. A. Batusov, S. A. Bunyatov, V. M. Sidorov, and V. A. Yarba 1966 8 p refs Submitted for Publication

(JINR-E-2774)

The events of ^8He production and decay in negative pion capture by carbon and oxygen nuclei were detected in photoemulsion. The probability of ^8He production is $(2-3)\ 10^{-6}$. The mass of ^8He was measured to $M_{^8He} = (7481.3 \pm 0.9)$ MeV. Author (NSA)

N67-14097# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
SMALL ANGLE ELECTRON PROTON ELASTIC SCATTERING CROSS SECTIONS FOR MOMENTUM TRANSFERS BETWEEN 10 AND 105 F^{-2}
W. Bartel, P. Dudelzak, H. Krehbiel, J. M. McElroy, U. Meyer-Berkhout et al Jul. 1966 14 p refs Prepared jointly with Hamburg Univ.
(DESY-66/20)

A report is presented on the results of an electron–proton scattering experiment in which the elastic scattering cross section for momentum transfers between 10 and 105F^{-2} was measured with a precision of about 5%. NSA

N67-14098# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
APPLICATIONS OF THE MAXIMUM LIKELIHOOD METHOD IN HIGH ENERGY PHYSICS [DIE ANWENDUNG DER MAXIMUM LIKELIHOOD METHODE IN DER HOCHENERGIEPHYSIK]
W. P. Swanson Jun. 1966 32 p refs In GERMAN; ENGLISH summary
(DESY-66/17)

A lecture on applications of the maximum likelihood method in high energy physics is presented. Both the ordinary and extended MLM are introduced. Four practical examples are given: the analysis of proton polarization by scattering on carbon; the determination of spin density matrix elements; the determination of amounts, masses, and widths of resonances plotted on a triangle plot; and the determination of branching ratios in a two-step decay process. Minimization processes are described in detail. Likelihood ratios for hypothesis discrimination are defined and the meaning of these ratios is discussed. References to other examples in the literature are given. Author (NSA)

N67-14099*# National Bureau of Standards, Washington, D. C.
ADDITIONAL STOPPING POWER AND RANGE TABLES FOR PROTONS, MESONS, AND ELECTRONS
Martin J. Berger and Stephen M. Seltzer Washington, NASA, 1966 40 p refs Sponsored by NASA
(NASA-SP-3036) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Tables of the stopping power and range are presented for lithium fluoride, silicon, germanium, liquid hydrogen, propane, and freon. The densities and mean excitation energies for these materials, and the density effect correction for protons in muscle and bone are also given. N.E.N.

N67-14127 Polish Academy of Sciences, Warsaw.
DIFFERENTIAL RECOMBINATION CHAMBER [DIFFERENTSIALNAYA REKOMBINATSIONNAYA KAMERA]
M. Zeiczinski and K. Czarnowetzki Jun. 1966 16 p refs
(INR-739/XIX/D) CFSTI: HC $1.00/MF $0.50

Purpose of the differential recombination chamber described in this paper is the detection of spontaneously produced radiation doses and the measurement of the quality factor of mixed radiation. The chamber utilizes the volt–amperage characteristics resulting from linear energy loss during ionization. Operating principles and construction of the chamber are discussed. Schematics showing the arrangement of electrodes, and of feeding sources for the saturated and unsaturated regions of the chamber are given. Transl. by K.W.

N67-14139# National Reactor Testing Station, Idaho Falls, Idaho.
MODEL FOR CALCULATING THE SLOW NEUTRON SCATTERING BY LIQUID D_2O
H. L. Mc Murry Aug. 1966 25 p refs
(Contract AT(10-1)-1230)
(IN-1020) CFSTI: HC $2.00/MF $0.50

The Nelkin (N) model for room temperature water considers each H_2O molecule to posses free translational motion and assumes the intermolecular interaction produces single torsional oscillation of 0.06 ev. The McMurry–Russell (MR) model is a modification which allows for aggregates of H_2O molecules which exhibit 1-f modes below 0.025 eV associated with group translation, together with intermediate modes with energies up to 0.125 eV associated with group rotations. Both the N and MR models assume that each H_2O molecule retains its three internal modes of 0.2, 0.46 and 0.46 eV. These models were scaled to suit D_2O by reducing the energies of the modes with characteristic energies in the range $0.025 < E \leq 0.125$ eV by $1/\sqrt{2}$, and by introducing the the known internal D_2O frequencies. In addition, the scaled MR model (called MD in this work) was altered by selecting the fraction of free D_2O molecules to give a least squares fit to the experimental data. 17% of free D_2O molecules gives the scaled MR model which optimize the fit to the 22°C scattering law data of Haywood. This agreement is quite good and is superior to that obtained with the scaled N model. Agreement with recent double differential scattering data obtained by Whittemore using 0.157, 0.206 and 0.300 eV neutrons at 22°C is quite good for both the scaled MR and scaled N models. However, Whittemore's data show structure which is not predicted by either model. The scaled MR model with 53% free D_2O molecules optimizes agreement with Haywood's 150°C data. The agreement is fair at $\beta \leq 0.5$ and is superior to the scaled N model. For $\beta > 0.5$ both models give rather poor agreement. Author (NSA)

N67-14140# National Reactor Testing Station, Idaho Falls, Idaho.
SLOW NEUTRON SCATTERING KERNELS FOR H_2O AT 423°K AND 550°K
H. L. Mc Murry Aug. 1966 9 p refs
(Contract AT(10-1)-1230)
(IN-1019) CFSTI: HC $1.00/MF $0.50

The McMurry–Russell (MR) model for water assumes that 10% of the molecules are free, and the rest are divided equally between aggregates in which the effective masses for H scattering are 75 and 150. Each aggregate exhibits characteristic frequencies in the range $0 < E \leq 0.125$ eV which are chosen to make the calculated scattering agree with Brugger's room temperature data. A simple modification is described in which the fraction of free molecules in the MR model is adjusted to give a least squares fit to Haywood's 423°K data and to Page's 550°K data. The fractions of free molecules are 0.25 and 0.28, respectively. Agreement with the 423° data is reasonably good. Agreement with the 550° data is only fair. In both cases the modified MR model is in better agreement than the Nelkin (N) model. Author (NSA)

N67-14165# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
A MONTE CARLO TREATMENT OF THE INTERACTION OF AN ELECTRON BEAM WITH A HEAVY TARGET
M. P. Ruffle Sep. 1966 67 p refs
(AERE-R-5172) HMSO: 9s

The report describes the general strategy adopted and the treatment of the various reactions involved in investigating the interaction of an electron beam with a heavy target by a Monte Carlo computer program. The purpose of the program is to predict the distribution of the heat generated and the neutrons produced. Some results for typical targets are shown, and the performance of the program in general is discussed. Author

N67-14168 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
INTENSITY AND RESOLUTION IN THE TIME-OF-FLIGHT POWDER DIFFRACTOMETRY
B. Buras and A. Holas Aug. 1966 60 p refs
(Contract IAEA-255/RB)
(INR-745/II/PS) CFSTI: HC $3.00/MF $0.50

As has been shown in recent years, the time-of-flight method can be applied to neutron structure analysis of powdered crystals. In this paper mathematical expressions have been developed allowing to calculate the integrated intensities and half-widths of reflections as functions of parameters of the experimental set-up, i.e. the scattering angle, the parameters of the chopper, the flight-path, the shape and dimensions of the sample, the dimensions of the counter, collimators etc. Based on these expressions a procedure of optimization of the experimental conditions has been developed. Using this procedure several experimental arrangements are optimized and examples of those are given. Author

N67-14184# Atomic Energy Commission Research Establishment, Riso (Denmark). Dept. of Physics.
SOME NUMERICAL DETERMINATIONS OF THE EFFECTIVE NEUTRON TEMPERATURE OF A GIVEN THERMAL-NEUTRON SPECTRUM
P. Villemoes and B. Fastrup Jan. 1962 29 p refs
(RISO-33) CFSTI: HC $2.00/MF $0.50

In the description of the spectrum of thermal neutrons produced in a reactor it is customary to use the Westcott spectrum for the calculation of reaction rates. The thermal part of the spectrum is in that approximation described by a Maxwellian distribution with an effective neutron temperature Tn. Different experimental methods for the determination of Tn are investigated, and their temperature criteria are established and shown to be different. A numerical investigation of the neutron-temperature criteria belonging to different experiments for the determination of the effective neutron temperature in a thermal reactor spectrum is carried out. In a given theoretical neutron spectrum the results of experiments like transmission through 1/v absorber, reaction-rate determination in non-1/v absorbers and a least squares fit to a Maxwellian spectrum are compared. Author (ESRO)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N67-13420*# Case Inst. of Tech., Cleveland, Ohio.
AN ANALYSIS OF CONFINED MAGNETOHYDRODYNAMIC VORTEX FLOWS
David E. Loper Washington, NASA, Nov. 1966 153 p refs
(Grant NsG-198)
(NASA-CR-646) CFSTI: HC $3.25/MF $1.00 CSCL 20I

The vortex flow of a viscous, incompressible and electrically conducting fluid confined between two finite flat plates (with a net radial mass flow) in the presence of an applied axial magnetic field is considered. The details of the velocity field including boundary layer blockage and redistribution of radial mass flow are of primary concern. The analysis is limited to the case of the separation distance between the two end plates being small compared with the radius of the plates; this allows the momentum equations to be uncoupled from the electromagnetic equations. The momentum equations are linearized and solved for the velocities and the pressure as Fourier series. The temperature and electromagnetic variables are then found. The velocity and temperature results are plotted and discussed, showing the influence of the magnetic effects upon the flow pattern. Author

N67-13536*# Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
THEORETICAL AND EXPERIMENTAL STUDIES OF HIGH TEMPERATURE GAS TRANSPORT PROPERTIES Final Report, 11 May 1964–10 May 1965
10 May 1965 172 p refs
(Contract NASw-916)
(NASA-CR-80649; RAD-TR-65-7) CFSTI: HC $5.00/MF $1.00 CSCL 20I

Column voltage gradients and radial temperature distributions have been measured at several current levels for cylindrically symmetric electric arcs in argon and nitrogen. These data have been analyzed to obtain thermal conductivity as a function of temperature by integrating the Elenbaas–Heller energy equation. The effects of emission and absorption of far ultraviolet radiation have been studied using information available in the literature. It is concluded that these ultraviolet effects are probably responsible for the 40-percent discrepancy between the experimental and theoretical conductivities of argon, and the much larger discrepancies occurring in nitrogen. Approximate interaction potentials between ground-state atoms and atomic ions at large internuclear separations have been calculated for the systems $N–N^+$ and $O–O^+$ using a generalization of the Heitler–London method. The unperturbed atoms and ions were represented by analytic Hartree–Fock wavefunctions from the literature, including all electrons of each system. The calculated interaction potentials have been used to evaluate the average cross sections for charge exchange and diffusion in these systems, neglecting the polarization effect. Author

N67-13628# California Univ., Livermore. Lawrence Radiation Lab.
THE MAGNETIC PULSE IN A COLD COLLISION-FREE PLASMA
Douglas E. Gonzales (Ph.D. Thesis) 7 Feb. 1966 136 p refs
(Contract W-7405-ENG-48)
(UCRL-7170) CFSTI: $4.00

The steady-state motion of a magnetic disturbance propagating transverse to a uniform magnetic field in a cold collision-free plasma was investigated. Electrostatic interactions were ruled out by assuming that the plasma constituents have equal mass. The disturbance consists of a pulse —or series of pulses—of extra magnetic flux parallel to the original flux. Each pulse has the net effect of displacing the entire plasma among the direction of propagation. If the speed of the solitary disturbance is between one and two times the Alfvén speed in the undisturbed plasma, the individual particle orbits associated with the perturbation do not cross over one another. However, for speeds greater than this, particle crossovers occur corresponding to a symmetrical looped particle trajectory when viewed in a frame of reference moving with the disturbance. The nonlinearity of the plasma-field equations governing the multiple-stream loop region necessitates a numerical solution there, the external tail segments being specified by familiar single-valued analytic results. These solutions are also shown to be unique. In the event that extra stress is applied at the plasma boundary, not one but a series of pulses of extra flux is forced into the plasma. Physically, the extra stress is required to establish the steady-state periodic structure, since the individual pulses repel one another. Although the variation of the periodic solutions with pulse speed and extra stress is rather complex, their periodic structure corresponds closely to a superposition of solitary pulse solutions with regular spacings along the direction of propagation. In fact, multiple overlapping of the elementary

looped trajectories result for some solutions when the propagation speed is greater than twice the undisturbed Alfvén speed. Rarefaction pulses with a net magnetic flux less than that of the reference state have also been found to exist, but only for the case of a total flux reversal. These solutions represent waves traveling in a direction opposite to that of the compression pulses described above when viewed in a frame moving with the mean particle velocity, and are related to them by a simple change of variables. Reduced "Rankine-Hugoniot" type relations for the magnetic shock problem are calculated on the basis that the multiple overlap pulses may effectively represent a finite temperature plasma. The actual shock transition linking two overlap states is concluded to be time dependent, and a model for investigating its structure is described. Procedures for utilizing the equal mass results in an analysis of the pulses generated in an unequal mass plasma are also given.
Author (NSA)

N67-13679*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MAGNITUDE OF NONLINEARITIES IN COLLISIONLESS MAGNETOPLASMA WAVES
Richard R. Woollett Washington, NASA, Jan. 1967 35 p refs (NASA-TN-D-3778) CFSTI: HC $2.00/MF $0.50 CSCL 20I

A perturbation technique is used to obtain approximate solutions to the nonlinear hydromagnetic equations (Ohm's law and the equation of motion of a fluid element) of a cold collisionless plasma. The assumed model consequently consists of (1) a linear harmonic wave that is infinite in extent, and (2) nonlinear waves that are harmonic and propagate in the direction of the fundamental. The perturbation technique limits application to regions where nonlinearity is small. Some idea of the importance of the nonlinearity can be obtained by observing the magnitude of the terms. For a transverse perpendicularly propagating wave in atomic hydrogen, nonlinear effects are shown to be important near and below a frequency of 10^7 second^{-1} for a fundamental amplitude of 1 statvolt per centimeter or greater and for a plasma density of 10^{12} ions per cubic centimeter and a magnetic field intensity of 10^4 gauss. For a longitudinal perpendicularly propagating or a right or left circularly polarized wave, nonlinear effects are only important for very large wave amplitudes.
Author

N67-13681 Radio Corp. of America, Camden, N. J.
PLASMA PHYSICS RESEARCH AND ENGINEERING
1966 103 p refs

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N67-13683 RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
MICROWAVE MEASUREMENTS OF PLASMAS
Morrel P. Bachynski, Freleigh J. F. Osborne, Allan I. Carswell, Brian W. Gibbs, and Claude Richard *In its* Plasma Phys. Res. and Eng. 1966 p 7–11 refs (See N67-13681 04-25)

Microwave techniques for high speed plasma measurements are described, and the inherent difficulties introduced by the measurement system are assessed. The finite dimensions of the plasma and the limitations of microwave focusing devices are considered. Detailed quantitative measurements of plane wave interaction with isotropic and anisotropic plasmas are illustrated.
Author

N67-13684 RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
APPLICATIONS OF THE TRANSPORT COEFFICIENTS IN A PLASMA
Issie P. Shkarofsky *In its* Plasma Phys. Res. and Eng. 1966

Many diverse subjects are discussed briefly, with an extensive bibliography to more detailed literature included. The subjects covered include: (1) electrical conductivity in shock heated argon; (2) the accepted use of the generalized Appleton–Hartree equation for the refractive index in ionospheric work; (3) verification of the prediction that the electron temperature is higher than the ion temperature above the D-layer ionosphere; (4) damping of waves near the electron cyclotron frequency; (5) the diffusion of plasma across a sufficiently low magnetic field; (6) the electrical and heat conductivity coefficients in the limit of zero current and (7) temperature determination from electrical conductivity measurements. Other applications given are: method of calculation of transport coefficients for an arbitrary variation of the electron-neutral collision frequency, not necessarily a power law; relaxation times for an anisotropic temperature; damping of plasma oscillations; and equilibrium electron temperature in ohmic heating. Also mentioned are recent work in the fields of: application to resistive, sheer, etc. instabilities; plasma wave corrections to the transport coefficients; and hydrothermomagnetic waves.
Author

N67-13685 Radio Corp. of America, Princeton, N. J.
COMPARATIVE STUDIES OF PLASMA DIAGNOSTICS
Charles C. Peterson and Joseph F. Dienst *In its* Plasma Phys. Res. and Eng. 1966 p 18–25 refs (See N67-13681 04-25)
(Contract AF 33(615)-7814)

Experiments were conducted in which Langmuir probe and microwave techniques were applied to the same plasma; these comparative studies have shown excellent agreement, and have led to better understanding of the plasmas. To obtain convenient and reproducible conditions, these plasmas were generated with high-purity rare-gas discharges and had electron densities in the range 10^9 to 10^{12} cm^{-3}. The comparative density measurements are summarized, and the techniques, their refinements, and some possible applications are discussed. Author

N67-13686 Radio Corp. of America, Camden, N. J.
LASER MEASUREMENT OF ELECTRON DENSITY IN DENSE, HIGH-TEMPERATURE PLASMA
A. Boornard, L. J. Nicastro, and James Vollmer *In its* Plasma Phys. Res. and Eng. 1966 p 26–30 refs (See N67-13681 04-25)

Temperatures in the range of 14,000° to 18,000°K are attainable in the potential core region of an argon plasma jet operating in the laminar mode. Measurement of the electron concentration in such high temperature plasma by conventional probe and microwave techniques is extremely difficult. The use of laser interferometer techniques appears to be promising, and electron concentration measurements obtained using a HeNe two-cavity laser interferometer are presented. Use is made of the 3.39-μm radiation to obtain a large phase shift; the visible 6328-angstrom radiation is used for alignment and detection. The effects of scattering of the laser radiation by the plasma jet when operated in the turbulent mode are also reviewed. Author

N67-13687 RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
LABORATORY SIMULATION OF REENTRY PLASMA
Allan I. Carswell *In its* Plasma Phys. Res. and Eng. 1966 p 31–35 refs (See N67-13681 04-25)

The problems connected with the radar characteristics of the reentry plasma and reentry communications are discussed. It is pointed out that the electromagnetic properties of such plasma flow fields are critical in interpreting radar returns from the vehicle–plasma system and to communication with the vehicle through the plasma sheath. The laboratory facilities designed for studying these phenomena are described, with the two basic requirements listed as (1) the availability of a theory which can adequately describe the physical situation, and (2) an experimental capability to make measurements of the quantities described by the theory. Details are given on a system developed to measure the backscattering characteristics of laboratory plasma flow fields; a schematic diagram is included. Various methods for alleviating the reentry communications blackout phenomenon are reviewed, with attention focused on a technique involving the seeding of electronegative gases into plasma flow fields. M.G.J.

N67-13688 Radio Corp. of America, Camden, N. J.
INTERACTION OF ELECTROMAGNETIC WAVES WITH IONIZED ROCKET EXHAUSTS
A. Boornard *In its* Plasma Phys. Res. and Eng. 1966 p 36–40 refs (See N67-13681 14-25)

Three aspects of the rocket exhaust plasma which enter into the determination of electromagnetic-wave, ionized-exhaust interaction effects on communications and tracking systems are discussed. These are: (1) processes leading to the formation and loss of free electrons in the rocket-engine combustion chamber, during expansion in the thrust chamber, and within the exhaust jet; (2) spatial variation of the basic plasma parameters within the jet as governed by the gas mass density and temperature variations; and (3) interaction of electromagnetic waves with the nonuniform exhaust plasma. Indications of the extent of signal attenuation to be expected in actual rocket exhausts are given. Author

N67-13690 RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
GUIDED WAVES IN GASEOUS PLASMAS
Tudor W. Johnston *In its* Plasma Phys. Res. and Eng. 1966 p 46–49 refs (See N67-13681 04-25)

The general cold longitudinally-magnetized plasma waveguide involves extremely difficult analysis, since it must consider at least two media: plasma and the gap at the wall, not to mention dielectric containers, etc. One of these is generally gyrotopic—i.e., the tranverse current J_t depends on both E_t and $B \times E_t$. All but the simplest cases require a computer for solutions. Useful simplifying assumptions and concepts are: nongyratory media and small perturbations $\nabla \times E \approx 0$ (large wave vector), near cutoff (small longitudinal wave vector), single medium (no gaps), very high or low frequencies, perturbation theory, and coupled modes. General features and a concrete example of the plasma waveguide problem are discussed. Author

N67-13691 Radio Corp. of America, Camden, N. J.
PLASMA-COATED SURFACE AS A WAVEGUIDE
L. W. Zelby *In its* Plasma Phys. Res. and Eng. 1966 p 50–51 refs (See N67-13681 04-25)

Waveguiding characteristics of a surface impedance externally coated with a layer of plasma are determined for a general system with primary propagation along the z-axis, and then reduced to specific cases where the surface impedance represents that of a corrugated surface, a comb structure, a dielectric, and a dielectric-coated conductor. Since plasma coatings occur around a space vehicle during reentry, they might be turned into a communications aid, instead of a problem, if the coating is utilized as a guiding structure. Author

N67-13692 RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
RESONANCES IN THE IONOSPHERE MAGNETOPLASMA
Tudor W. Johnston and Issie P. Shkarofsky *In its* Plasma Phys. Res. and Eng. 1966 p 52–55 refs (See N67-13681 04-25)
(Contract NASw-957)

Alouette, the swept-frequency topside-ionosphere sounding satellite, detected ringing, evident as spikes, on ionograms at certain frequencies. These ringing phenomena proved to be the local plasma frequency, the transverse resonance frequency, and harmonics (up to the fifteenth) of the cyclotron frequency. Collisions being negligible, the classical Vlasov electron plasma dispersion equation is applicable, from which these particular ringing frequencies are easy to infer; but the complicating effects of orientation, antenna size, time behavior, etc., require and are undergoing advanced theoretical analysis. The Alouette low-frequency noise receiver also detected characteristic frequency phenomena involving ions associated with the electron–ion hybrid frequency and the zero-gyration electron–ion frequency. A bibliography of the pertinent literature in the field is included. Author

N67-13693 RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
LABORATORY SIMULATION OF GEOPHYSICAL PHENOMENA
Freisigh J. F. Osborne, Morrel P. Bachynski, Joseph V. Gore, and Michael A. Kasha *In its* Plasma Phys. Res. and Eng. 1966 p 56–59 refs (See N67-13681 04-25)

Two different experiments are described in which complex geophysical phenomena were simulated in the laboratory. The first experiment is a scaled laboratory study of the interaction between the solar wind and the magnetosphere. The second deals with the perturbations induced by a space satellite with long antennas in the surrounding environment due to the motion of the satellite in a magnetized plasma. The geophysical situation relevant to each experiment is described, as well as the laboratory arrangement, and the interpretation and significance of the experimental results. Author

N67-13774# Columbia Univ., N. Y. Plasma Lab.
BOLTZMANN'S EQUATIONS WITH BREMSSTRAHLUNG
Alan Oppenheim Jul. 1966 42 p refs
(Contract AF 49(638)-1634)
(Rept.-27; AD-640401) CFSTI: HC $2.00/MF $0.50

The power density of bremsstrahlung radiation from a fully ionized plasma is developed from a binary collision analysis which includes the Debye shielding length in a consistent way. A cutoff in the minimum impact parameter is used which is completely consistent with a wide variety of velocity distribution functions including the Maxwellian equilibrium states. The power density is shown to vary linearly with the temperature for a Maxwellian plasma rather than with the square root of the temperature as predicted from Kramer's model. Above 4700 Kelvin the power density from the formula predicts a higher rate of bremsstrahlung emission. These results are used to develop a tractable form for inelastic collision integrals in Boltzmann's equations. Suitable moments of these Boltzmann's equations give the radiation cooling equations which replace the fluid conservation equations for momentum and energy density. The cooling terms are evaluated for Maxwellian plasma. Author (TAB)

N67-13886# Ion Physics Corp., Burlington, Mass.
PHYSICAL PHENOMENA IN BOMBARDMENT ION SOURCES
I. Kohlberg and S. Nablo *In* AGARD Phys. and Technol. of Ion Motors 1966 p 155–206 refs (See N67-13881 04-28)

A discussion of the important physical mechanisms and principles of operation of electron bombardment ion sources is presented with specific references to both the Lewis geometry and the duoplasmatron configuration. The nature of the arc instabilities in the duoplasmatron and their ultimate interpretation as ion-acoustic wave phenomena are rendered together with a treatment of plasma characteristics measured in the baffled region of the arc. A brief review of the configuration and characteristics of sources of the Lewis geometry is given. Data recorded during dc operation with mercury vapor and pulsed operation with the inert gases are used in a discussion of those parameters critical to the high performance of the source demanded in the engine application. Those phenomena of importance in the development of a working theory of ion source behavior are evaluated. Detailed treatments of the calculation of the electron distribution function in a weak magnetically confined plasma, resonance charge transfer and ion kinetics in the region of low electric field to pressure ratio, the process of anomalous diffusion, and the calculation of the radial potential and plasma distribution for the Lewis source are presented. The applicability of these considerations in interpreting the behavior of the Lewis type source is then evaluated within the limits of the available experimental data. Author

N67-13958# Royal Aircraft Establishment, Farnborough (England).
GASEOUS PLASMAS IN THE LABORATORY
H. K. P. Neubert Mar. 1966 55 p refs
(RAE-TR-66073) CFSTI: HC $3.00/MF $0.50

Theoretical and experimental aspects of gaseous plasmas are discussed, including macroscopic and microscopic plasma concepts and the propagation of plasma waves. Difficulties of solving the fundamental equations representing the microscopic model and limitations to the validity of the macroscopic approach are indicated. The importance of the propagation properties of disturbances in gaseous plasmas is emphasized, and the behavior of high and low frequency waves with both infinitesimal and finite amplitudes is discussed. Methods for production, confinement, and diagnostics of laboratory plasmas are surveyed; and special attention is given to electrostatic and microwave probing techniques. Applications of gaseous plasmas are also considered. M.W.R.

N67-13974# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
HIGH TEMPERATURE PLASMAS BY LASER HEATING Final Report
E. W. Sucov, J. L. Pack, A. V. Phelps, and A. G. Engelhardt 6 Apr. 1966 67 p refs Submitted for Publication
(Contract AT(31-1)-3472)
(TID-22928) CFSTI: HC $3.00/MF $0.75

Studies were made of the confinement in a magnetic mirror of a plasma produced by focussing a Q-switched laser beam on aluminum targets in the form of disks, foils, and spheres. High speed photographs show that one component of the plasma generated from flat targets is asymmetric and moves toward the laser with a velocity of about 10^7 cm/sec. The plasma generated from ball targets is roughly symmetrical with respect to the origin and expands much more slowly. In the presence of a mirror magnetic field of ratio 2:1, the expansion velocities are not appreciably reduced. However, the duration of the luminosity from a slower constituent of the plasma is increased by a factor of about 5, i.e., from 1 μsec to about 5 μsec, indicating that some confinement has occurred. In addition, microwave interferometer measurements show the confinement of a slow component of the disk plasma in the magnetic field with an electron density of about 5×10^{11} cm^{-3} at times as late as 50 μsec. Electrostatic probes provide an independent verification of the maximum expansion velocity which corresponds to an ion kinetic energy of about 1.4 KeV. Time integrated spectra of the plasma show lines from excited states of doubly ionized aluminum. Microwave attenuation measurements lead to an apparent electron temperature of the order of 0.02 ev at times later than 1 μsec. Analysis of microwave and other data show that radial density gradients probably exist in some plasmas. Author (NSA)

N67-14004# Stichting Voor Fundamenteel Onderzoek Der Materie, Jutphaas (Netherlands). Instituut Voor Plasma-Fysica.
EQUILIBRIUM AND STABILITY OF A TOROIDAL SCREW PINCH
C. Bobeldijk, L. H. Th. Rietjens, P. C. T. van der Laan, and F. Th. de Bats Jun. 1966 16 p refs Submitted for Publication Sponsored by EURATOM and Ned. Organisatie Voor Zuiver Wetenschap. Onderzoek
(Rept.-66-32; NP-16266)

A toroidal plasma column, produced and confined by a rapidly rising helical magnetic field is being studied. This "screw pinch" is of interest because it is in equilibrium and is completely reproducible. The discharge vessel is a quartz torus with major and minor diameters of 72 and 12 cm. Plasma currents (axial j_z and azimuthal j_θ) are induced by two orthogonal primary coils, which are simultaneously connected to capacitor banks ($E_z = 5$ kJ and $E_\theta = 7.5$ kJ). Both circuits have a ringing frequency of 70 kHz. During the first microsecond the plasma collapses; then the column

drifts about 0.5 cm to the outer wall and remains in this position, slightly off the tube axis, until the end of the first half cycle. The plasma is kept in this equilibrium position by the compression of the B_θ field between the plasma column and the metal shell surrounding the torus. The necessary gaps in the shell are constructed with special care. During the 7 μsec of the first half period no instabilities have been observed. This stable behavior is found even if the pitch of the magnetic field is varied between wide limits; expressed in terms of the axial current, a variation between approximately 4 to 12 times the Kruskal limiting current does not impair the reproducibility. A large-amplitude oscillation, excited by the implosion, is observed. The frequency agrees with the frequency of the stable m=0,k=0 mode, predicted by the normal mode analysis. From measured Stark broadening a density of 2×10^{16} cm^{-3} was derived, which corresponds to a compression ratio (radius of the tube divided by plasma radius) of 3. In a 15 micron Hg helium discharge a temperature of 20 ev has been measured. Author (NSA)

N67-14045# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

DEVELOPMENT AND TESTING OF A PIEZOELECTRIC PRESSURE PROBE WITH HIGH-RESOLVING POWER [ENTWICKLUNG UND ERPROBUNG EINER HOCHAUFLOESENDEN PIEZOELEKTRISCHEN DRUCKSONDE]

W. Katsaros Mar. 1966 64 p In GERMAN; ENGLISH summary
(IPP-1/46)

Pressure measurements in rapidly varying dense plasmas are of great interest for plasma diagnostics. Such measurements are meaningful only if the smallest time interval which can be resolved by the equipment is at least three times shorter than the duration of the process to be investigated. The major purpose of this work is a development of piezoelectric probes with the aim of improving the presently available time resolving power by a factor of ≈3. This purpose was approximately achieved and it turned out that further improvement appears impossible because of fundamental technical and physical limitations. A test of the probes was combined with pressure investigations in an inverse pinch. The results of the pressure measurements and of concurrent density determinations made it possible to carry out a detailed investigation of shock wave processes in an inverse pinch. The piezoelectric probe which was developed satisfied the following requirements: time resolving power about 80 ns; spatial resolving power about 0.5 mm; sensitivity abvut 5 torr/mv; and accuracy about ±10%. Since the piezoelectric transducer is quite sensitive against electrical perturbations from the plasma the pressure impulse which is to be investigated is transmitted to the transducer through a pressure guide. This pressure guide consists of a cylindrical quartz rod with diameter ϕ≈0.3 mm and length 1=150 to 250 mm. In order to achieve a high sensitivity, a ceramic (P T.2) with very high piezoelectric coefficient is used. In order to obtain an accuracy of ±10%, a new calibrating method was developed. A high-voltage pulse excites a piezoelectric shock generator and this generator then yields a pressure pulse the amplitude and shape of which may be varied. This pulse is used for calibrating the probe. Author (NSA)

N67-14077# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.

INSTABILITY OF PLASMA WITH CAPTURED PARTICLES IN TOROIDAL GEOMETRY [NEUSTOICHIVOST PLAZMY NA ZAPERTYKH CHASTITSAKH V TOROIDALNOI GEOMETRII]

B. B. Kadomtsev and O. P. Pogutse [1966] 24 p refs In RUSSIAN
(IAE-1149)

It is shown that instability similar to the instability of channel plasma in traps with magnetic mirrors can be developed in a toroidal discharge with longitudinal magnetic field. Such instability developed in particles captured between mirrors was investigated. Author (NSA)

N67-14078# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.

PLASMA EQUILIBRIUM IN CONFINED TOROIDAL MAGNETIC CONFIGURATIONS [RAVNOVESIE PLAZMY V ZAMKNUTYKH TOROIDALNYKH MAGNITNYKH KONFIGURATSIYAKH]

V. D. Shafranov [1966] 14 p In RUSSIAN
(IAE-1151)

Distortions of magnetic field configurations caused by currents in plasma were studied in order to establish plasma equilibrium in magnetic fields. The strongest effects of plasma pressure in closed systems are exhibited by the plasma pinch toroidal shift outward from the center of curvature. This effect may change the shape of magnetic surfaces and even the topology of magnetic configurations. The shift of magnetic surfaces and general topology of toroidal equilibrate configurations are discussed. Author (NSA)

N67-14079# International Centre for Theoretical Physics, Trieste (Italy).

WKB APPROXIMATION IN THE COMPLEX PLANE AND APPLICATIONS TO PLASMA THEORY

A. Skopupski May 1966 38 p refs
(IC-66/45)

The following problems concerned with the WKB technique applied to the equation $d^2\psi/dz^2+q^2(z)\psi=0$ in the complex plane are considered: the errors and the applicability conditions along any line L, the properties of the Stokes and the anti-Stokes lines, and the connection formulas for zeros and simple poles of $q^2(z)$. The results obtained generalize those of N. Fröman and P. O. Fröman. Two typical applications are considered: (i) ionospheric propagation of the EM waves through a region with a resonance and a cutoff. An expression for the transmission coefficient is derived and it is shown to be exact for a simple model discussed by Budden, and (ii) evaluation of the eigenfrequencies for the "quasi-modes" introduced in plasma stability theory. For any number of zeros and poles of $q^2(z)$ in the complex plane the "quantization condition" specifying the eigenfrequencies is derived and reduced to a form convenient for approximations. It is shown that the location of poles of $q^2(z)$ defines a sector in the complex plane where the eigensolution $\psi(z)$ is not localized. Author (NSA)

N67-14113*# North Carolina State Coll., Raleigh.

STUDY OF INSTABILITIES IN LINEAR HALL CURRENT ACCELERATORS

G. W. Garrison, Jr., H. A. Hassan, and R. K. Seals, Jr. Washington, NASA, Jan. 1967 52 p refs
(Grant NsG-363)
(NASA-CR-676) CFSTI: HC $2.50/MF $0.50 CSCL 20I

The stability of a linear Hall current accelerator with applied axial electric and radial magnetic fields against a screw type perturbation is investigated. The analysis is based on the ion and electron conservation equations and takes into consideration the effects of ionization. It is shown that the observed instability cannot be explained when the axial magnetic field is identically zero even when the unperturbed potential and density distributions have both radial and axial dependence. On the other hand, when the axial component of the magnetic field is small, but not zero, the column is unstable, in the absence of an axial density gradient, to a right-handed helical perturbation ($m = -1$). The resulting instability, which is of the Kadomtsev–Nedospasov type, is analyzed using a normal mode analysis. Author

N67-14138# Sandia Corp., Albuquerque, N. Mex.

A GENERALIZED MAGNETOHYDRODYNAMIC ENTRANCE FLOW MODEL. I: MOMENTUM INTEGRAL METHOD

W. S. Saric and K. J. Touryan Aug. 1966 51 p refs
(Contract AT(29-1)-789)
(SC-RR-66-358) CFSTI: HC $3.00/MF $0.50

The hydromagnetic flow of a conducting, incompressible fluid is analyzed by using a two-conductivity model and a momentum integral method. The model implies a highly conducting viscous layer with Hall effects and a cool inviscid core. Author (NSA)

N67-14288# Paris Univ., Orsay (France). Dept. of Sciences.
PLASMA INSTABILITY AT ANISOTROPIC TEMPERATURE [INSTABILITE DANS UN PLASMA A TEMPERATURE ANISOTROPE]
Carlos Montes Lozano (Ph.D. Thesis) Jun. 1966 45 p refs In FRENCH Sponsored by ESRO
CFSTI: HC $2.00/MF $0.50

Electromagnetic instability of anisotropic plasma caused by interactions of current fluctuations is discussed first in its physical process, then extended beyond long wavelength approximation through an exact dielectric description of collisionless plasma, and finally in the light of instabilities obtained by an oblique propagation coupled mode. The instability growing rate in the presence of ions is mathematically determined. ESRO

N67-14306# Atomic Energy Commission Research Establishment, Riso (Denmark).
RELAXATION PHENOMENA BEHIND A STRONG SHOCK IN HYDROGEN. I. ATTAINMENT OF THE VIBRATIONAL EQUILIBRIUM STATE
C. T. Chang Feb. 1962 28 p refs
(RISO-357) CFSTI: HC $2.00/MF $0.50

The time required to establish the equilibrium states of translational, rotational and vibrational degrees of freedom of the gas behind a strong shock in hydrogen are estimated. It is shown that when $T>T_v^*$, translational and rotational degrees of freedom reach their equilibrium states much faster than that of the vibrational degrees of freedom. The relaxation time of the translational and the rotational degrees of freedom are of the order of magnitude of the gas kinetic collision time; that of the vibrational degrees of freedom possibly is of the order of magnitude given by the existing quantum theory of Herzfeld and Schwartz. When $T>T_v^*$, the Herzfeld–Schwartz theory breaks down. Simple consideration, based on the adiabaticity concept of the collision processes, indicates that possibly at such a temperature range all the three modes reach their equilibrium states at essentially the same rate. Author (ESRO)

N67-14307# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Groupe de Recherches sur la Fusion.
1965 ACTIVITY REPORT OF THE RESEARCH GROUP FOR CONTROLLED FUSION [RAPPORT D'ACTIVITE DU GROUPE DE RECHERCHES POUR L'ANNEE 1965]
277 p refs In FRENCH Prep. in Assoc. EURATOM
(EUR-CEA-FC-352) CFSTI: HC $6.00/MF $1.50

Progress has been made in theoretical plasma description, especially of instabilities, and experimental studies of phenomena e.g. interactions with beams and the electrical breakdown of a gas with a laser. In the field of magnetic mirrors and ion injection the stability of a plasma MM II was observed at a density where similar experiments reveal instabilities. Experiment DECA II confirmed the stability of magnetic wells, giving rise to the problem of causes that restrict the life of a plasma in a stable configuration. In the field of toroidal plasma it has been found out that the conditions of stability of the toroidal tubular pinch were essentially the same as in cylindrical geometry. The disclosure of the gravity of instability bound to the density gradient in mirror machines is very important for the program at Fontenay where magnetic mirrors play the first role. A project DECA III is investigated to observe experimentally the principal confinement limitation in a stable configuration from a magnetodynamic point of view. ESRO

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N67-13539# Lockheed Missiles and Space Co., Palo Alto, Calif.
THERMOELECTROMOTIVE FORCE DURING PLASTIC DEFORMATION
N. S. Akulov and A. A. Lukhvich [1966] 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 10, no. 9, 1966 p 632–635
CSCL 20L

Basic premises of the theory of the change in the thermal electromotive force (EMF) which arises in the plastic deformation of a metal are developed. The question of the influence of dislocations on the thermal EMF is of interest not only from the viewpoint of elucidating the physics of the phenomenon, but also because this effect, as we shall show, affords the possibility of following the change in the density of defects during plastic deformation, on the basis of the statistical theory of dislocations. Consideration is given to two factors affecting the thermal EMF: firstly, the internal lattice defects produced by the plastic deformation, to which primarily dislocations and vacancies refer, and secondly, elastic lattice distortions and the associated changes in electron density. Author

N67-13643# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.
SUBMILLIMETER WAVE AMPLIFICATION IN A PERIODIC STRUCTURE. HIGH-FREQUENCY CONDUCTIVITY, CARRIER WAVES, AND ACOUSTIC AMPLIFICATION IN DRIFTED SEMICONDUCTOR PLASMAS
Josef M. Mayr and Kjell Bloetekjaer Stockholm, Telefonaktiebolaget L. M. Ericsson, 1966 75 p refs Ericsson Technics, v. 22, no. 2, 1966 p 111–183
(Contract AF 61(052)-888) HC $3.00/MF $0.75

The gain of a travelling-wave amplifier for submillimeter waves was studied, using a periodic structure of the linear magnetron type as a delay line. The dispersion relation was derived when losses are neglected, and it was concluded that high gain at submillimeter wavelengths can be obtained even when losses are taken into account. However, the current densities required are very high, and the dc velocity interval within which gain can be obtained increases with current density. Also considered are high-frequency conductivity, carrier waves, and acoustic amplification in drifted semiconductor plasmas. The effect of temperature modulation of rf conductivity is discussed, using a phenomenological description of energy relaxation, momentum relaxation, and intercarrier collisions. A theory is evolved which is applied to a discussion of acoustic amplification in piezoelectric semiconductors. It was shown that the nonisothermal effects limit the maximum gain that can be achieved at high frequencies. L.E.W.

N67-13865*# Stanford Univ., Calif. Microwave Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF COLLECTIVE MICROWAVE PHENOMENA IN SOLIDS Semiannual Status Report, 1 Apr.–30 Sep. 1966
M. Chodorow Dec. 1966 14 p
(Grant NGR-05-020-165)
(NASA-CR-80727; SASR-1; ML-1493) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The following three developments are discussed: (1) experiments in the steady state and transient behavior of freely

propagating, high field dipole domains in n-type GaAs. Results showing the variation of domain voltage and charge as a function of field external to the domain are presented. Discussed are also the propagation constant and growth rate of small signal space charge waves in high resistivity GaAs, where domain formation is impossible. (2) electroacoustic amplifiers to operate in the microwave frequency ranges. Fabricating techniques were developed for miniature sandwich type structures in which the various layers consist of electroacoustic transducers, thin film electrical contacts, and the active amplifier material. (3) analyses and calculations of electronic deflection of the direction of a laser beam. It is proposed to utilize the Brillouin scattering process and the frequency of an acoustic wave which is excited in a crystal to control the optical beam direction. K.W.

N67-13694 Radio Corp. of America, Princeton, N. J.
INSTABILITIES IN SOLID-STATE PLASMAS
Martin C. Steele and Bayran Vural *In its* Plasma Phys. Res. and Eng. 1966 p 60–63 refs (See N67-13681 04-25)

Various types of streaming instabilities in solids are described, and the solid state analogs of desirable instabilities in gaseous plasmas are discussed. Examples of specific solids with realistic parameters are presented to delineate the potential advantages and limitations of such devices. Consideration is given to the two stream instabilities that can exist in the presence of an electromagnetic field with both transverse and longitudinal electric field components, and situated in a longitudinal static magnetic field. The analysis shows that there are four regions in which nonconvective instabilities can occur. The results of quantitative calculations confirm the qualitative picture which was developed in analogy to two stream instabilities in electron beams. M.G.J.

N67-13695 Laboratories RCA, Inc., Tokyo (Japan).
ALFVEN WAVES IN BISMUTH PLASMA
Brian W. Faughnan *In its* Plasma Phys. Res. and Eng. 1966 p 64–66 refs (See N67-13681 04-25)

Alfven wave propagation at 52 Gc/s was studied in bismuth at 4.2°K. The two classes of waves predicted theoretically were observed and in general their characteristics were in good agreement with calculations. It was found that the waves could be seen at weaker magnetic fields than that corresponding to the lowest cyclotron frequency of the carriers, because the proper choice of polarization can result in poor coupling to the cyclotron wave which would normally provide very strong damping for the propagation. Author

N67-13696 Radio Corp. of America, Princeton, N. J.
MICROWAVE EMISSION FROM SOLID-STATE PLASMAS
Robert D. Larrabee, Walter A. Hicinbothem, and John J. Thomas *In its* Plasma Phys. Res. and Eng. 1966 p 67–69 refs (See N67-13681 04-25)
(Contract AF 33(615)-1608)

Microwave radiation from inductive posts of indium antimonide was observed in a broadband spectrum extending down to at least 3 Gc/s and up to at least 44 Gc/s. This emission occurs when the indium antimonide, cooled to 77° K and placed in a dc magnetic field in excess of 3 kG, is pulsed to an average electric field ranging from 300 to 700 V/cm. The power output, integrated over the spectrum from 3 to 44 Gc/s is approximately 1 mW. It is anticipated that, with more efficient coupling between the solid and output waveguide, the power level will be increased and operation as an amplifier and a single frequency oscillator can be achieved. Low frequency (10 to 20 Mc/s) oscillations in the sample current were also observed. In some experiments these oscillations were correlated with the microwave emission while in others no correlation could be found. Experiments were performed to determine the pertinent mechanism of the microwave emission. The results suggest that drifted solid state plasma instabilities are involved. Author

N67-13697 Laboratories RCA, Inc., Tokyo (Japan).
PROPAGATION IN SOLID-STATE-PLASMA WAVEGUIDES—NONRECIPROCAL DEVICES
Ryogo Hirota and Minoru Toda *In its* Plasma Phys. Res. and Eng. 1966 p 70–72 refs (See N67-13681 04-25)

When a magnetic field is applied to a material containing a plasma, which had its surfaces coated with metal, the propagation properties of such solid state plasma waveguides become highly nonreciprocal. They show promise for use in miniature microwave circuits. For example, an isolator has been constructed from indium antimonide of dimensions 0.8×8×1 mm which gives 13 dB isolation at 24 Gc/s. Many other passive devices (phase shifters, couplers, circulators, switches, modulators) should be possible using these properties. Author

N67-13698 Laboratories RCA, Inc., Tokyo (Japan).
SOLID-STATE-PLASMA DELAY LINES
Yasuo Kuniya and Maurice Glicksman *In its* Plasma Phys. Res. and Eng. 1966 p 73–75 refs (See N67-13681 04-25)

The growth and time delay characteristics of the helical plasma density wave in a germanium bar were investigated with parallel electric and magnetic fields under conditions of various injection levels. Qualitative agreement with previous observations on the relation between growth constant and frequency were obtained. The time delay was observed to be linear with distance, of magnitude about 22 μs/cm, and almost independent of frequency and magnetic field used in the 30 to 200 kc/s range. It is considered possible to construct useful delay lines with low loss or some gain, covering frequencies in the audio range (effective radius 1 mm), FM-TV range (effective radius 10 μm), and microwave X-band (effective radius 1 μm). Typical parameters indicate that Ge, InAs, and InSb are likely materials. Author

N67-13723 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
MICROFRACTOGRAPHY OF THIN FILMS
J. M. Nieuwenhuizen and H. B. Haanstra *In its* Philips Tech. Rev., Vol. 27, No. 3/4 1966 p 87–91 refs (See N67-13721 04-34)

The characteristics of some evaporated thin films depend to a marked extent on the angle at which the atoms arrive at the substrate. Replicas of fracture surfaces of relatively thick films of aluminium (thickness approx. 1 micron) have been made successfully by means of a simple technique. Photographs taken with the electron microscope show clear pictures of the cross-section of such a film. From these "fractographs" conclusions can be drawn concerning the structure of the films and the way in which the structure is influenced by the evaporation angle. Author

N67-13785*# National Aeronautics and Space Administration, Washington, D. C.
DEPENDENCE OF RELATIVE QUANTUM YIELD OF LUMINESCENCE OF ZnO ON LENGTH OF EXCITATION WAVE [ZAVISIMOST' OTNOSITEL'NOGO KVANTOVOGO VYKHODA LYUMINESTSENTSII ZnO OT DLINY VOLNY VOZBUZHDENIYA]
F. I. Vergunas and F. F. Gavrilov Oct. 1966 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 59, no. 7, 1948 p 1273–1275
(NASA-TT-F-10390) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The yield dependence of spontaneous ZnO luminescence on the length of the excitation waves was investigated. The nature of this dependence for most phosphor crystals has not yet been adequately established, due to the difficulty of measuring absorption in powders and the existence for most such phosphor crystals of prolonged luminescence which may be a source of errors

in measuring the yield of spontaneous luminescence. Zinc oxide is used because it offers better measurements of the dependence in question that other phosphor crystals. Absorption was determined for ZnO films 10^{-4}–10^{-5} cm thick by measuring the attenuation in the light passing through them. The luminescence of zinc oxide, according to measurements of its electrical and optical properties, is attributed to the movement of electrons of the local level of atoms of the excess zinc to the primary zone.
Author

N67-13798*# National Aeronautics and Space Administration, Washington, D.C.
THE NATURE OF THE ANOMALOUSLY HIGH PHOTOVOLTAGES (AHP-EFFECT) IN SEMICONDUCTOR FILMS [O PRIRODE AFN-EFFEKTA V POLUPROVODNIKOVYKH PLENKAKH]
E. I. Adirovich, V. M. Rubinov, and Yu. M. Yuabov Dec. 1966 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 168, no. 5, 1966 p 1037–1040
(NASA-TT-F-10470) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The photodiffusion and the p-n junction models are investigated, emphasizing the high photovoltage sign inversion, the dependence of the photovoltage on the light intensity, and the influence of the angle of incident light. It is concluded that the AHP effect in Ge, Si, and GaAs films is caused by a photodiffusion mechanism, and that it is caused by micro-p-n junctions in CdTe films.
N.E.N.

N67-13800*# National Aeronautics and Space Administration, Washington, D.C.
LUMINESCENCE SPECTRA OF ZINC OXIDE [SPEKTRY LYUMINESTSENTSII OKISI TSINKA]
F. I. Vergunas and F. F. Gavrilov Nov. 1966 7 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 18, no. 2, 1948 p 224–227
(NASA-TT-F-10454) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Experimental data are discussed with respect to the temperature effects of prior thermal processing on the extinction curves at different values of U, the distance from the levels of the zinc atoms to the conductivity zone. Spectral luminescence curves of ZnO subjected and not subjected to processing are presented. The values of U obtained from the temperature dependence of dark conductivity are compared with measurements from the luminescence extinction and from the radiation and absorption spectra. It was concluded that the same centers are responsible for the luminescence and dark conductivity, and that prior thermal processing does affect the luminescence spectra.
N.E.N.

N67-13913# Phylatron Corp., Columbus, Ohio.
SILICON DIODE FAST NEUTRON DOSIMETER. PHASE III: REVERSE-RECOVERY LIFETIME AS A FUNCTION OF TEMPERATURE
W. W. H. Closser, J. M. Swartz, and M. O. Thurston Edgewood Arsenal, Md., Nuclear Defense Lab., Nov. 1966 33 p refs
(Contract DA-18-035-AMC-101(A))
(NDL-TR-83-III; AD-642582) CFSTI: HC $3.00/MF $0.65

P–I–N wide-base diodes were made from n- and p-type, float-zone silicon. The diodes were irradiated with fast neutrons and annealed at 58°C, 100°C, 150°C, and 200°C for 175 hours at each step. Reverse-recovery lifetime as a function of temperature was taken before and after radiation and after each anneal. The temperature dependence of the lifetime indicated very shallow levels which are not in agreement with the existing literature.
Author (TAB)

N67-13985# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
A THEORY OF ELECTRICAL CONDUCTANCE OF METALS WITH NONMAGNETIC IMPURITIES [K TEORII ELEKTROPROVODNOSTI METALLOV S NEMAGNITNYMI PRIMESYAMI]
Yu. Kagan and A. P. Zhernov 1965 32 p refs In RUSSIAN; ENGLISH summary
(IAE-1028)

A theory of electrical conductivity of metals with impurities was developed which takes into account the deformation of the phonon spectrum caused by incorporation of the impurities and changes in the scattering of electrons on individual atoms. The admixture contribution to the resistivity is given for the entire temperature range. At low temperatures and low impurities concentrations, the electron scattering is governed by a T^2 relation, the interference of scattering on impurities and on the perturbed phonon spectrum changes the relation to T^4, while scattering on the deformed phonon spectrum changes it to $\sim T^5$. At increasing temperatures there appear anomalies which in the case of heavy admixtures lead to quasi-local levels. At high temperatures the impurity contribution changes linearly with temperature with a slope of arbitrary sign. The results obtained are used to explain the majority of known experimental results in the high and intermediate temperature range. Accurate measurements of impurity resistance at low temperatures are needed for verification of the conclusions.
NSA

N67-13992# Sandia Corp., Albuquerque, N. Mex.
PHOTOCONDUCTIVITY PROCESSES IN LOW MOBILITY ORGANIC MATERIALS
F. N. Coppage and R. G. Kepler Jul. 1966 6 p refs Presented at IEEE Ann. Conf., Palo Alto, Calif.
(Contract AT(29-1)-789)
(SC-DC-66-1823; CONF-660705-3) CFSTI: HC $1.00/MF $0.50

Recent studies on photoconductivity processes in anthracene crystals made it possible to calculate the number of carriers created in polymers when they are subjected to high-energy radiation. The results are described and applied to some recently reported measurements on polystyrene. Reasonable values were found for such quantities as carrier mobility and trap densities.
Author (NSA)

N67-14020# Northwestern Univ., Evanston, Ill. Technological Inst.
CONTRIBUTION TO THE UNDERSTANDING OF THE HIGH TEMPERATURE OXIDATION OF METALS Final Report, 1 Feb. 1962–31 May 1966
J. Bruce Wagner, Jr. 17 Jun. 1966 81 p refs
(Contract AT(11-1)-1126)
(TID-23268) CFSTI: HC $3.00/MF $0.75

Investigations of doping semiconducting oxides are summarized. Li-doped NiO and CoO are discussed as examples of the doping process. Investigations are also reported on equilibrium vacancy concentrations in the Wüstite phase field around a reported P-to-n transformation at 950 to 1250°C. Transformation mechanisms are discussed. Results of studies concerning oxidation of iron alloys containing 0.59 to 1.06 at. % Ti at 900 to 1100°C in CO_2–CO mixtures are presented. An investigation to determine the mechanisms of oxidation of Cu and Cu–Au alloys in CO_2 at 1000°C is summarized. Results of thermogravimetric and Seebeck effect measurements on Li-doped CoO crystals are included.
NSA

N67-14043# Oak Ridge National Lab., Tenn.
LOW ENERGY ELECTRON STUDIES IN INDIUM AND MAGNESIUM
H. L. Pray, R. D. Birkhoff, M. Y. Nakai, and R. H. Ritchie (M.S. Thesis—Tenn. Univ.) Sep. 1966 67 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1565) CFSTI: HC $3.00/MF $0.75

Low energy electron transmission of thin films of magnesium and indium was investigated. For magnesium, as the electron energy was increased, direct observations were made for interactions of the electron beam with the surface plasma, volume

plasma, conduction electrons, and the L_I and L_{II} electron shells. The L_I and L_{II} ionization potentials were measured as 49.5 ev and 76.7 ev, respectively. The stopping power for magnesium was measured as 2.49 ev/Å at 1460 ev, 2.54 ev/Å at 1775 ev, 2.5 ev/Å at 1870 ev, and 2.38 ev/Å at 1930 ev. For indium, direct observations were made for interactions with the surface plasma, volume plasma, conduction electrons with N_1 electron shell. The ionization potential for the N_1 shell was measured as 130 ev. NSA

N67-14084*# California Univ., Berkeley. Lawrence Radiation Lab.
THERMIONIC EMISSION FROM PLANAR MONOCRYSTALLINE TUNGSTEN
Sheldon Ira Schreiner (M.S. Thesis) 1 Jun. 1966 54 p refs Sponsored in part by NASA
(Contract W-7405-ENG-48)
(NASA-CR-80879; UCRL-16690) CFSTI: HC $3.00/MF $0.50 CSCL 20L

A thermionic diode and a vacuum system to test it were constructed to investigate the bare work function of (110) and (111) planar monocrystalline tungsten. The collector was (100) monocrystalline copper held at constant temperature. The work function for (110) tungsten was found to be 5.22±0.01 V over the temperature range 2163 to 1697° K. For (111) tungsten the work function was found to be 4.74 ±0.15 V over the range 2237 to 2013° K. At lower temperatures effects attributed to adsorption on the (111) surface were observed. The (100) copper work function was found to be 4.07 and 4.43 V for the two runs made but neither value is representative of a truly bare (clean) surface. The system pressure throughout the runs varied from 5×10^{-10} to 8×10^{-9} torr. Author (NSA)

N67-14132# Oak Ridge National Lab., Tenn.
LISTS OF AVAILABLE AND DESIRED MATERIALS AND AVAILABLE CRYSTAL-GROWTH REFERENCES (ULTRAPURE INORGANIC RESEARCH MATERIALS)
Aug. 1966 52 p
(Contract W-7405-ENG-26)
(ORNL-RMIC-5) CFSTI: HC $3.00/MF $0.50

Lists are presented on: available high purity inorganic solid state research materials; materials for which references on crystal growth can be provided; and materials about which information has been requested but for which no source was found. N.E.N.

N67-14161# Phylatron Corp., Columbus, Ohio.
SILICON DIODE FAST NEUTRON DOSIMETER. PHASE I: EVALUATION OF RESPONSE VERSUS STARTING MATERIAL
J. M. Swartz, B. H. Chase, and O. M. Thurston Oct. 1966 39 p refs
(Contract DA-18-035-AMC-101(A))
(NDL-TR-83-I; AD-641843) CFSTI: HC $2.00/MF $0.50

The report presents the results obtained from an investigation of the effects of n- or p-type) silicon, resistivity, and method of crystal fabrication (pulled or float-zone) on the response of silicon-diode fast-neutron dosimeters. The high-level lifetime, the reverse-recovery lifetime, and the current-voltage characteristic were measured for diodes fabricated from each type of starting material, and these parameters were then followed as the diodes were exposed to various neutron fluences. Preliminary results of isochronal annealing experiments and the effects of maintaining the diodes at low temperatures during irradiation are also presented. It was expected that the high-level damage constant, derived from the high-level lifetime, would be independent of the resistivity of the starting material, and this was demonstrated experimentally. Annealing results suggest that at least seven levels are involved in the degradation of lifetime by fast neutrons, and studies of devices irradiated at 77° K and 273° K revealed an increased amount of observed damage. Author (TAB)

N67-14169# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
MAGNETIC HYPERFINE STRUCTURE OF ^{57}Fe IMPURITY NUCLEUS IN NON-MAGNETIC MATERIAL
Jozef Bara, Halina U. Hrynkiewicz (Jagellonian Univ.), Andrzej Z. Hrynkiewicz, Mihailo Karapendzic, and Tadeusz Matlak Jul. 1966 5 p refs Submitted for Publication
(REPT.-489/PL) CFSTI: HC $1.00/MF $0.50

The temperature dependence of the magnetic hyperfine structure of dilute paramagnetic ^{57}Fe impurity atoms in a non-magnetic host lattice is observed. The strength of magnetic hyperfine coupling decreases very slowly with increasing temperature. Author

N67-14171 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
DIFFUSION OF Zn^{65} IN β, γ, ϵ INTERMETALLIC PHASES Cu-Zn- SYSTEM [DYFUZJA Zn^{65} W FAZACH MIEDZYMETALICZNYCH β, γ, ϵ UKLADU Cu-Zn]
St. Gabrycki 1966 23 p refs In POLISH; ENGLISH summary
NR-729/XIV/PS) CFSTI: HC $1.00/MF $0.50

Investigations of Zn^{65} diffusion in polycrystals of the Cu-Zn system β, γ, and ϵ intermetallic phases were carried out in the temperature range between 210-410°C. Activation energies and D_o coefficients were calculated. Author

N67-14254*# Massachusetts Inst. of Tech., Cambridge.
DEFECTS IN THE COMPOUND Bi_2TE_3 CAUSED BY IRRADIATION WITH PROTONS
P. Chaudhari and Michael B. Bever (1966) 18 p refs
(Grant NsG-496)
(NASA-CR-80847) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Single crystal foils of Bi_2Te_3 were irradiated with 7.5 MeV protons at two levels of flux to the same integrated dose of 5.5×10^{18} protons/cm^2. The specimens were examined by transmission electron microscopy. After irradiation with a flux of 1.8×10^{13} protons/cm^2/sec, clusters of point defects ranging in size from approximately 50 to 250 A.U. were observed. These clusters annealed out during examination in the electron microscope. After irradiation with a flux of 3.0×10^{13} protons/cm^2/sec, clusters of interstitial atoms and clusters of vacancies could be distinguished. Hexagonal areas were observed after irradiation with the higher flux. Irradiation also promoted the rearrangement of dislocations. Segments of dislocation intersected the surface of the specimens and dislocations acquired a jagged appearance. Author

N67-14267# Royal Aircraft Establishment, Farnborough (England).
SOME PHENOMENA OCCURING IN THERMALLY-GROWN SILICON DIOXIDE
P. J. Holmes Jul. 1966 37 p refs
(RAE-TR-66226) CFSTI: HC $2.00/MF $0.50

A short review is presented of recent papers relating to the effects which take place in the passivating oxide of silicon devices as a result of the application of bias and elevated temperatures. The various theories which have been put forward in explanation are outlined and their limitations discussed. It is obvious that a large proportion of the experimental discrepancies between different laboratories' results is due to differences in the details of the oxidation methods used, and to impurities introduced in subsequent processing. Author (ESRO)

N67-14327# South Dakota School of Mines and Technology, Rapid City. Dept. of Physics.
INTERNATIONAL CONFERENCE ON THE PHYSICS OF SEMICONDUCTORS, KYOTO, JAPAN, 8–13 SEPTEMBER 1966. INTERNATIONAL SYMPOSIUM ON LATTICE DEFECTS IN SEMICONDUCTORS, TOKYO, JAPAN, 5–6 SEPTEMBER 1966
Robert G. Morris 15 Oct. 1966 19 p refs
(Contract Nonr-2964(01))
(TR-20; AD-640275) CFSTI: HC $1.00/MF $0.50

The report is a personal view of the conferences covering the papers which the author heard and which particularly interested him. Thus it cannot be taken as a definitive report of the conference.
TAB

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N67-13672*# Marquardt Corp., Van Nuys, Calif.
EXTRATERRESTRIAL RELIQUEFACTION OF CRYOGENIC PROPELLANTS Final Report, May 1964–Dec. 1965
L. A. Gibson, W. K. Wilkinson, and J. Tamusaitis 11 Dec. 1965 338 p refs
(Contract NAS8-5298)
(NASA-CR-80720; Rept.-6099) CFSTI: HC $7.00/MF $1.50 CSCL 21I

Reliquefier component design and cycles were investigated to study the feasibility of reducing or eliminating boil-off losses in extraterrestrial cryogenic propellant storage systems. Estimates were made of the mass and performance of reliquefiers for liquid hydrogen and liquid oxygen storage systems at lunar equatorial sites. The hydrogen-nitrogen dual pressure parallel cascade cycle and the Hampson cycle were found to be the most practical lunar hydrogen and oxygen reliquefier cycles, respectively. Component analyses and design studies were made of vertical and horizontal radiators; and finned tube, cross-counterflow tubular, and plate fin type heat exchangers. Diaphragm compressors and rotating machinery were also investigated. Radiator studies for earth orbit reliquefiers were conducted to establish the equivalent sink temperature as a function of altitude. Partial reliquefiers, externally powered and self-powered space power units, and expander-driving compressors were investigated for reducing cryogenic propellant boil-off losses. The feasibility of catalytic conversion for hydrogen reliquefaction was established.
K.W.

N67-13674*# Union Carbide Corp., Bound Brook, N. J. Polymer Research and Development Dept.
SATURATED HYDROCARBON POLYMERIC BINDER FOR ADVANCED SOLID PROPELLANT AND HYBRID SOLID GRAIN Quarterly Report, 1 Aug.–31 Oct. 1966
J. E. Potts ed. 31 Oct. 1966 17 p ref Prepared for JPL
(Contracts NAS7-100; JPL-951210)
(NASA-CR-80718; QR-4) CFSTI: HC $1.00/MF $0.50 CSCL 21I

Factors which might adversely influence the attainment of satisfactory levels of carboxyl content in the prepolymer were examined. The choice of solvent in the molecular weight determination had previously been found to be very critical. The titrimetric procedure for determining neutralization equivalent was found to be lacking in accuracy and was altered. The possibility that polymeric anhydrides were being formed during sample work-up was tested; no evidence for the presence of anhydrides was found. The monomer neohexene was analyzed for chain transfer impurities; none were found. The oxygen functionality of the prepolymer made with DMAB initiator was found to decrease with increasing batch reaction time, indicating a changing reaction environment. Further examination of these products demonstrated concentration of carboxyl groups, which was not compatible with the copolymer.
Author

N67-14265 Rocket Propulsion Establishment, Westcott (England).
COMPOSITE SOLID PROPELLANT IGNITION: IGNITION OF AMMONIA AND OTHER FUELS BY PERCHLORIC ACID VAPOUR
G. S. Pearson and D. Sutton London, Min. of Aviation, Jun. 1966 23 p refs
(RPE-TR-66-8) CFSTI: HC $1.00/MF $0.50

The ignition of polyisobutene, polyurethane, polystyrene and polymethylmetacrylate has been studied with oxygen gas and with perchloric acid vapour under the same experimental conditions. All these fuels ignited with perchloric acid vapour at 200° to 250°C whereas ignitions with oxygen were only achieved at temperatures above 350°C. Ignition of ammonia, methane, ethylene and isobutene was not achieved by perchloric acid vapour in the absence of a surface at 200° to 250°C. In the presence of a surface the order of decreasing ignitability was ammonia, isobutene, ethylene, methane. Cupric chromate and ferric oxide were effective catalysts in the ignition of gaseous fuels with perchloric acid vapour. It is concluded that in ammonium perchlorate propellants the important reactions leading to ignition are heterogeneous rather than homogeneous, and that in a catalyzed propellant the reaction of ammonia and perchloric acid on the surface of the catalyst is the significant reaction.
Author (ESRO)

N67-14278# Applicazioi e Ricerche Scientifiche, Milan (Italy).
ELDO FUTURE PROGRAMME PRELIMINARY STUDY NO. 3-1. PART I: HIGH-ENERGY PROPELLANTS PROPERTIES AND PERFORMANCES
Jul. 1965 148 p refs
(ARSN-6) CFSTI: HC $4.00/MF $1.00

This report presents data on the propellant properties and characteristics which influence the design, operation and performance of a liquid rocket propulsion system. It considers a number (30) of high energy propellants and a number (88) of possible fuel oxidizer combinations of these propellants which should yield a minimum specific impulse of 300 sec. at sea level.
ESRO

N67-14308# Bolkow Entwicklungen, K. G., Munich (West Germany).
ELDO FUTUR PROGRAM PRELIMINARY STUDY NO. 3-1 PRELIMINARY STUDY ON THE USE OF HIGH-ENERGY PROPELLANTS AND DEFINITION OF AN ELDO-B LAUNCH VEHICLE PART I
Apr. 1964 138 p refs Work performed for Eldo
(Bolkow-RF-13) CFSTI: HC $4.00/MF $1.00

This paper reviews the state of the art of high energy propellants, assesses and compares their performance and considers their possible application. The propellants considered are combinations of the fuels liquid hydrogen or hydrazine with oxidizers liquid oxygen, liquid fluorine, oxygen/fluorine or oxygen bifluoride having specific impulse greater than 400 sec. It also discusses briefly use of metal additives with propellants.
ESRO

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N67-13570*# Thiokol Chemical Corp., Huntsville, Ala.
DESIGN AND DEVELOPMENT OF THE CASTOR IIA ROCKET MOTOR Final Report
W. W. Barnes 4 Feb. 1966 204 p
(NASA Order L-15993; Contract DA-01-021-506-ORD-1269(Z)) (NASA-CR-66250; Rept.-41-65) CFSTI: HC $6.00/MF $1.25 CSCL 21H

The TX354-3 motor was successfully developed and qualified to meet or exceed all requirements of the NASA development specification, P39-023, as revised, with exception of maximum thrust level. The maximum vacuum thrust of 70,100 pounds exceeds the 70,000 pound upper limit of P39-023 by 100 pounds. A tabulation of PFRT motor performance, including averages which are considered nominal for the TX354-3, is compared with requirements of P39-023. Eight TX354 motors were manufactured. Three motors were tested for development and four were tested for PFRT, two under simulated altitude conditions. All motors performed satisfactorily. One motor developed a propellant crack during the second low temperature cycle at 20°F and could not be fired. The propellant formulation was subsequently modified slightly to improve physical properties by reducing total solids loading from 89 percent to 88 percent, reducing plasticizer content by one percent, and adding two percent binder. No further cracking problems were encountered. One set of motor manufacturing tooling was made. A nozzle closure capable of withstanding a pressure differential of at least 27.5 psig but not more than 45 psig under static pressure loading and an external nozzle insulation blanket made of cork were developed. Author

N67-13600# College of Aeronautics, Cranfield (England). Dept. of Propulsion.
THEORETICAL ASPECTS OF GAS TURBINE COMBUSTION PERFORMANCE
A. H. Lefebvre Aug. 1966 25 p refs
(COA-AERO-163) CFSTI: HC $1.00/MF $0.50

A correlating parameter for gas turbine combustion performance, based on a burning velocity theory for primary zone combustion is derived. Various applications of this parameter are discussed and it is shown that the shape of correlated performance curves is directly related to the combustion processes taking place in the various zones of the chamber. An alternative, more basic, theory is presented in which it is assumed that the low-pressure performance of a spray-type combustor is controlled by a balance between the separate effects of chemical reaction, fuel evaporation and mixing. It is argued that combustion efficiency is a function of $p^x/^M$ where x=2.0, 1.7 or 1.0 depending upon whether the rate of heat release is governed by chemical reaction, fuel evaporation or mixing respectively. It is postulated that the amount by which values of x determined experimentally fall below 1.7 provides a useful practical indication of the extent to which mixing is intervening in the overall combustion process. At high pressures the mixing process predominates, x=1, and it is shown that, for any given fuel-air ratio, the rate of heat release depends only on flame-tube geometry and mode of fuel injection, and is independent of chamber size, pressure loss factor and the operating conditions of pressure, temperature and velocity. The basic principles involved in the design of primary combustion zones for maximum volumetric heat release rate and maximum stability in terms of wide burning range are discussed. Author

N67-13645# College of Aeronautics, Cranfield (England). Dept. of Propulsion.
A DESIGN METHOD FOR THE DILUTION ZONES OF GAS TURBINE COMBUSTION CHAMBERS
A. H. Lefebvre and E. R. Norster Feb. 1966 23 p refs
(CoA-AERO-169) CFSTI: HC $1.00/MF $0.50

The achievement of a satisfactory and consistent distribution of temperature in the efflux gases discharging into the turbine is considered in relation to the design and development of gas turbine combustion chambers. Previously obtained data on the mixing of cold jets when injected into hot streams under conditions when the temperature and velocity of the hot and cold streams, the injection-hole diameter, the angle of injection, and the mixing length could be accurately controlled and varied over a wide range are applied to demonstrate a logical method of dilution zone design and to provide quantitative data on the rate of exchange between temperature transverse quality and the relevant design parameters such as dilution zone length, dilution hole diameter, and pressure loss factor. The effects of chamber inlet velocity and inlet velocity profile are also examined. It was proposed that for many practical purposes the aerodynamic performance of a combustion chamber can be defined in terms of the parameter β, where β is the ratio of the flametube pressure loss factor to the overall pressure loss factor. L.E.W.

N67-13699 Radio Corp. of America, Princeton, N. J. Physical Research Group.
ELECTRIC PROPULSION FOR SPACECRAFT
Thomas J. Faith, Jr. and Hans W. Hendel *In its* Plasma Phys. Res. and Eng. 1966 p 76-80 refs (See N67-13681 04-25)
(Contract AF 49(638)-134z)

Details are given on a laboratory model electric propulsion unit which uses electron cyclotron resonance (ECR) to ionize a mercury plasma and to raise the electron temperature. Momentum is transferred to the ions self-generated electric fields. An efficiency of 30% was obtained at a power level applicable to orbit corrective missions (50 watts). A propellant utilization factor of about 50% was also achieved at this power. Systems analyses indicate that an ECR thrustor using standard solar cell panels will be competitive for a wide range of orbit corrective missions. The long life expectancy of the electrode-less ECR thrustor is cited as a major advantage relative to other, probably shorter lived electric thrustors. M.G.J.

N67-13719*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR INVESTIGATION OF A TURBINE FOR HIGH-TEMPERATURE-ENGINE APPLICATION
Warren J. Whitney, Edward M. Szanca, Thomas P. Moffitt, and Daniel E. Monroe Washington, NASA, Jan. 1967 27 p refs
(NASA-TN-D-3751) CFSTI: HC $1.00/MF $0.50 CSCL 21E

The stator component of a turbine designed to study the problems associated with turbines for high-temperature-engine application, was investigated experimentally. In addition to the overall performance characteristics, such as weight flow and outlet-flow angle, the blade-surface static-pressure distributions at the hub, mean, and tip sections were obtained. The stator passed design equivalent weight flow (39.9 lb/sec) at the design values of pressure ratio that occurred simultaneously at the inner and outer walls. The measured stator outlet angle agreed closely with the design outlet angle across the radial span for a range of pressure ratio. The total- to static-pressure ratios across the stator at the inner and outer walls were in excellent agreement with the outlet pressure distribution calculated for free-vortex outlet-flow conditions for pressure ratios up to incipient choking. The variation of the stator-throat pressures at the inner and outer walls with over-all pressure ratio indicated that choking started at the hub and progressed radially outward until choking was reached at the tip. A

comparison of the blade-surface velocities obtained experimentally with those evolved from the design procedure showed that the design procedure predicted fairly well the shape and magnitude of the blade-surface velocities. Author

N67-13791 National Aeronautics and Space Administration, Washington, D. C.
DYNAMIC BEHAVIOR OF JET ENGINES WITH AIR EXTRACTION BEHIND THE COMPRESSOR [DAS DYNAMISCHE VERHALTEN VON STRAHLTRIEBWERKEN BEI LUFTENTNAHME HINTER DEM KOMPRESSOR]
W. Dettmering and F. Fett Oct. 1966 17 p refs Transl. into ENGLISH from German Presented at 6th European Aeron. Congr. Munich, 1–4 Sep. 1965
(NASA-TT-F-10358) CFSTI: HC $1.00/MF $0.50 CSCL 21E

Starting with the thermodynamic relationships and the flow behavior of the individual structural groups of the engine, the transfer functions of all engine parameters are determined. The dynamic behavior of a turbojet engine without controls is described in detail, particularly as it is affected by interferences due to compressor air extraction. Data essential to the operating safety of the engine are examined. The investigation of engines with control systems is indicated. Author

N67-13852 Aerospace Corp., El Segundo, Calif.
HIGH ALTITUDE, HIGH VOLTAGE BREAKDOWN IN AN ELECTRIC PROPULSION FLIGHT TEST SYSTEM
L. R. Sitney and T. R. Shukay (Space Systems Div.) *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 185–209 (See N67-13842 04-12)

Selected data from the first flight test of an electric propulsion flight test system are presented. Arcing in the high voltage section of the flight test system at an altitude of approximately 1000 miles produced failures in various electronic components. Subsequent ground testing of the system has revealed that arcing occurs at pressures of the order of 10^{-2} torr. Factors which caused the high voltage breakdown at high altitudes and measures which have been taken since the flight to eliminate the cause of this breakdown are described. A general description of the entire payload system, emphasizing those features which were associated with high voltage breakdown, is presented. The results of a simulated flight trajectory of the entire flight test payload in an altitude simulation chamber are discussed since this testing represents the first known simulation of a boost phase time-pressure profile of a flight system. Author

N67-13881 Advisory Group for Aerospace Research and Development, Paris (France).
PHYSICS AND TECHNOLOGY OF ION MOTORS
Frank E. Marble and Jean Surugue, ed. New York, Gordon and Breach Sci. Publishers, Inc., 1966 412 p refs Proc. of the 13th Gen. Assembly of the Combust. and Propulsion Panel held at Athens, 15–17 Jul. 1963
(AGARDograph-88)

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15. APPLICATION OF ION THRUST MOTORS IN ATTITUDE AND POSITION CONTROL OF SATELLITES J. H. Molitor (Hughes Res. Labs.) p 393–422 refs (See N67-13896 04-28)

N67-13882 Electro-Optical Systems, Inc., Pasadena, Calif.
SURFACE ION SOURCE PHENOMENA AND TECHNOLOGY—I. IONIZATION AND TRANSPORT PHENOMENA AND PERFORMANCE OF POROUS IONIZERS
G. Kuskevics and J. M. Teem *In* AGARD Phys. and Technol. of Ion Motors 1966 p 3–78 refs (See N67-13881 04-28)

Cesium ionization and transport phenomena are discussed, and a summary is presented of the current status of experimental knowledge of both the fundamental phenomena and the consequent performance of practical porous refractory metal cesium ion sources. Experimental techniques are given for studying the intrinsic, macroscopic, and microscopic aspects of surface ionization and transport phenomena. Results are obtained on properties of cesium on various solid refractory metal surfaces such as tungsten and molybdenum. Macroscopic results of such parameters as critical temperatures, current density, neutral fraction (or ionization efficiency), and thermal emissivity are obtained for various practical ionizer materials as a function of their structural form, intrinsic materials, and surface impurities, together with the consequences of such results on ion source technology. Consideration is also given to the microscopic properties of porous ionizers as observed with the surface ion emission microscope. S.P.

N67-13883 Electro-Optical Systems, Inc., Pasadena, Calif.
SURFACE ION SOURCE PHENOMENA AND TECHNOLOGY—II. POROUS MATERIAL TECHNOLOGY
J. M. Teem and H. H. Todd *In* AGARD Phys. and Technol. of Ion Motors 1966 p 79–101 refs (See N67-13881 04-28)

The current status of porous refractory materials technology related to cesium contact ionizers is reviewed from a metallurgical viewpoint. Information is presented concerning ionizer materials requirements, the production of porous materials using wire, sheet, and sintered powder methods, a comparison of the metallurgical and ionizer properties of these various materials, methods of joining such porous materials to the non-porous refractory elements of vapor feed systems, and operating problem areas. Materials requirements for porous ionizer surfaces are particularly critical and the ability to satisfy such requirements is the pacing technological item connected with this type of electrical propulsion. Permeability, pore size, pore spacing, and uniformity must be carefully controlled if a high degree of ionization efficiency is to be obtained for cesium ion current densities above 10–15 ma/cm^2. Manufacturing methods must be capable of producing materials possessing characteristics as close to the optimum as possible with great accuracy and uniformity, both within a single batch and from batch to batch. Woven refractory wire cloth, finely spaced holes drilled in metal sheets, closely packed fine wire bundles (sintered together and then sliced perpendicular to the wire axes), and sintered powder compacts made from both angular (crushed) and spherical metal powders, are described from the viewpoints of fabrication techniques and the degree that the resultant material's properties approach the optimum. On these bases, porous tungsten materials produced by powder metallurgy methods from compacts of spherical powder appear most promising at this time, although other materials have shown good to satisfactory performance. Author

N67-13885# Illinois Univ., Urbana.
PHYSICS OF CHARGED COLLOIDAL PARTICLES AND THE TECHNOLOGY OF THEIR PRODUCTION
Charles D. Hendricks *In* AGARD Phys. and Technol. of Ion Motors 1966 p 139–153 refs (See N67-13881 04-28)

A brief history of the development of heavy particle propulsion is presented. The field is an outgrowth of electrical propulsion, and the heavy particle studies date from about 1952. Briefly, the methods of producing charged heavy particles, the scientists, their laboratories, and their techniques are surveyed. Advantages and disadvantages of the various methods of particle charging and production are discussed. Because of the special interests of the author, strong emphasis is placed on electrical spraying of liquids. A few of the most recent developments in this particular area are presented. Author

N67-13887 Elliott Bros., Ltd., London (England).
AN EXPERIMENTAL BOMBARDMENT ION SOURCE
P. C. Mc Neill *In* AGARD Phys. and Technol. of Ion Motors 1966 p 207–222 refs (See N67-13881 04-28)

The paper describes a 2.5 cm diameter bombardment ion source of the type suggested by Kaufman. Details of the performance are given and related to other published data. The maximum overall efficiency of the source was about 45% at a beam current density of about 3.0 milliamps per cm^2. The overall energy per ion was in the region of 10,000 eV. Although this value is large, it is generally consistent with the behaviour of scaled sources as suggested by Reader. Author

N67-13888 Hughes Research Labs., Malibu, Calif.
TECHNOLOGY AND DEVELOPMENT OF THE CONTACT ION ENGINE
George R. Brewer *In* AGARD Phys. and Technol. of Ion Motors 1966 p 225–254 refs (See N67-13881 04-28)

The current state of development and the important areas of technology of the cesium contact ion engine are discussed. A brief introductory description of the operation of this type of electric thruster is presented, followed by the current status and achievements of the past year or two. Some of the remaining technical problems in the development of the ion engine are discussed. The limitation on engine life due to accel electrode erosion from charge exchange ions is shown as a function of current density and neutral efflux, and means for reduction of this effect are listed. It is shown that the neutral evaporation rate of cesium from the ionizer is perhaps the most important factor in determining engine life and performance. Technical areas requiring attention of future engine system development are listed. Author

N67-13889 Electro-Optical Systems, Inc., Pasadena, Calif.
TECHNOLOGY AND DEVELOPMENT OF BOMBARDMENT ION ENGINES
R. C. Speiser *In* AGARD Phys. and Technol. of Ion Motors 1966 p 255–272 refs (See N67-13881 04-28)

The low density electron bombardment ion engine has been developed in two versions--the mercury engine and the cesium gas discharge ion engine. The differences in operation are discussed. In particular, the cesium device uses a cesiated cathode heated entirely by ion bombardment from the plasma. Both devices have similar performance with overall engine efficiencies of 65 to 80 percent at specific impulses of 5000 to 8500 seconds. Lifetime limitations as limited by the cathodes and erosion of the accelerating electrodes are considered. The latter effect implies a tradeoff between lifetime and thrust density. Author

N67-13890 Commissariat a l'Energie Atomique, Saclay (France).
RESEARCH ON IONIC PROPULSION [RECHERCHES SUR LA PROPULSION IONIQUE]
J. F. Bonnal, J. Caron, G. Mainfray, C. Manus, and G. Spiess *In* AGARD Phys. and Technol. of Ion Motors 1966 p 273–303 refs In FRENCH (See N67-13881 04-28)

Experimental results obtained from ionic propulsion studies are reviewed. The Kaufman mercury source that served as a basis for these studies is described, along with the beam characteristics, the values of propulsion rates, and the research facility. Also included are details on measures of neutralizing the beam, and the ionic density distribution inside the source. Transl. by R.U.

N67-13891 Space Technology Labs., Inc., Redondo Beach, Calif.
NEUTRALIZATION AND INTERACTION PHENOMENA IN A LOW-DENSITY ION EXHAUST
J. M. Sellen, Jr. *In* AGARD Phys. and Technol. of Ion Motors 1966 p 305–317 refs (See N67-13881 04-28)

The observed interaction phenomena in the low density plasma beams of the electrostatic thrust engines are discussed. The interaction of the electrons in the plasma with the electric field structure in the column, and the electron-magnetic field interaction are reviewed. Further phenomena considered are the electron-atom and electron-ion interactions and the generation of oscillations in the plasma column at the plasma frequency from the two-electron-stream-instability. The use of the plasma stream for plasma-vehicle studies in a plasma wind tunnel is described. Author

N67-13892 Politecnico di Torino (Italy). Ist. di Macchine e Motori Per Aeromobili.
ELECTROSTATIC PROPULSION BY POSITIVE AND NEGATIVE IONS [PROPULSION ELECTROSTATIQUE PAR IONS POSITIFS ET NEGATIFS]
G. Bussi and F. Filippi *In* AGARD Phys. and Technol. of Ion Motors 1966 p 319–342 refs In FRENCH (See N67-13881 04-28)

In connection with the requirement for neutralization of positive and negative ions in space travel, experimental studies were conducted on electrostatic propulsion. An analysis was made of maximum values of thrust to power ratios to evaluate their compatibility with neutralization requirements. Details are also given on thrust to surface, and thrust to power ratios of a jet for an electrostatic motor functioning by simple acceleration or by acceleration-deceleration. Schematics and mathematical expressions complete the technological data. Transl. by R.Li.

N67-13893 Elliott Bros., Ltd., London (England).
DENSITY-TIME PROFILES FOR AN ELECTRIC PROPULSION UNIT EFFLUX
I. R. Mc Nab and P. C. Mc Neill *In* AGARD Phys. and Technol. of Ion Motors 1966 p 343-356 refs (See N67-13881 04-28)

The initial particle densities (n_0) obtained from present electrical propulsion units indicate that, at altitudes between 50 and 200 miles, the decay of density in the efflux may be obtained using a diffusion approach: numerical density-time profiles are given. When $n_0 < 10^{12}$ ions/cm^3 the effects of recombination and ionization are shown to be negligible, the efflux remaining fully ionized. The results are compared with those for free molecular flow and the difference between the two approaches is explained. The effects of such highly ionized exhausts on radio communications between space vehicles and ground stations are discussed. Author

N67-13896 Hughes Research Labs., Malibu, Calif.
APPLICATION OF ION THRUST MOTORS IN ATTITUDE AND POSITION CONTROL OF SATELLITES
J. H. Molitor *In* AGARD Phys. and Technol. of Ion Motors 1966 p 393-422 refs (See N67-13881 04-28)

The first contemplated use of ion propulsion is in the attitude control and station keeping of a synchronous satellite. The major forces (e.g., solar-lunar attraction, earth's triaxiality, solar pressure, etc.) which tend either to perturb the satellite orbit or to modify its orientation are reviewed. The mission constraints which affect the engine system design, such as the impulse requirements associated with vernier orbit corrections, the magnitude of disturbance torques, and the required thrusting directions are presented. An evaluation is made of the tradeoffs among such critical mission and system parameters as attitude accuracy, average power utilization, energy storage requirements, duty cycle, thrust level, thrust intervals, and satellite mass and moments of inertia. From these tradeoffs the capabilities and requirements of both the attitude control and station-keeping systems can be determined for application over a wide range of satellite weights. In addition, an optimization and preliminary design of an ion engine attitude control and station-keeping system are given. Such system parameters as power level, thrust level, specific impulse, and weight, are specified. Author

N67-14128# Rocket Propulsion Establishment, Westcott (England).
ESTIMATION OF THE PERFORMANCE OF CYLINDRICAL SUPERSONIC DIFFUSERS
A. J. Cruttenden Dec. 1965 31 p refs
(RPE-TR-65/12) CFSTI: HC $2.00/MF $0.50

A method of estimation of the performance of cylindrical supersonic diffusers is detailed, using a semi-graphical method. Computer programs have been written to provide the full theoretical solution. The point of incipient flow separation in the divergent portion of a rocket nozzle is determined with the use of an empirical equation based on the correlation of experimental flow-separation data. Experimental and theoretical results are compared, and used in the design of a diffuser for simulating altitude test conditions with a low-pressure rocket combustion chamber. Author

N67-14183# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
THE POTENTIALITIES OF ELECTRIC PROPULSION IN THE NEAR FUTURE [LES PERSPECTIVES OFFERTES PAR LA PROPULSION ELECTRIQUE DANS UN AVENIR APPROCHE]
Jean Surugue, Jean Fabri, and Emile Le Grives [1966] 25 p refs In FRENCH Presented at the 17th Intern. Astronautical Congr., Madrid, 9-15 Oct. 1966 Submitted for Publication
(TP-394) CFSTI: HC $1.00/MF $0.50

Recent progress in solar-cell power generation calls for a renewed attention towards the potential of solar-powered electric propulsion to perform satellite or interplanetary spacecraft missions of interest in the near future. Various types of electric thrustors are candidates for such applications: low-powered ion thrustors using oxide or liquid-metal cathodes provide the best answer to requirements of attitude and position control of satellites. The next competitors are resisto-jets and pulsed-plasma engines. Travelling-wave plasma thrustors such as the short annular device under development will need higher power, in the order of 100 kW, and a nuclear power supply. Author (ESRO)

N67-14188# Societe pour l' Etude et la Realisation d'Engins Balistiques, Courbevoie (France).
ELDO FUTURE PROGRAM PRELIMINARY STUDY OF LIQUID HYDROGEN, LIQUID OXYGEN STAGES [PROGRAMME FUTUR ELDO AVANT-PROJECT D'ETAGES PROPULSIFS A HYDROGENE, OXYGENE LIQUIDES]
Jul. 1964 121 p In FRENCH Prepared for ELDO
DTA-10/4205) CFSTI: HC $4.00/MF $0.75

Design of two specific liquid hydrogen-liquid oxygen rocket motor stages of 30 and 7 ton mass are described as well as stage separation. The design of a rocket motor of 70 kN thrust is outlined. Their possible use as upper stages of a future ELDO-C launch vehicle are discussed. ESRO

N67-14200# Societe d'Etude de la Propulsion par Reaction, Villejuif (France).
PRELIMINARY STUDY OF A LIQUID OXYGEN-HYDROGEN ROCKET MOTOR OF 6 TONS THRUST [AVANT-PROJET DE MOTEUR-FUSEE A OXYGENE ET HYDROGENE LIQUIDES DE 6 TONNES DE POUSSEE]
Jul. 1965 402 p In FRENCH Prepared for ELDO
CFSTI: HC $4.00/MF $0.75

This report describes design and development plans for a liquid oxygen-hydrogen rocket motor of 6 ton thrust for use as an upper stage of an ELDO-B launch vehicle. It gives details of construction including cooling of the combustion chamber by liquid hydrogen. It also includes cost estimates. ESRO

N67-14275# Bolkow Entwicklungen K. G., Munich (West Germany).
DESIGN AND DEVELOPMENT PROPOSAL FOR A ROCKET ENGINE WITH 6 TONS THRUST: ELDO STANDARD PROPULSION UNIT FOR HIGH ENERGY UPPER STAGES
Oct. 1964 37 p refs Prepared for ELDO
(TR-542) CFSTI: HC $2.00/MF $0.50

A proposal for design of a hydrox. rocket engine of thrust 6 ton for use as high energy upper stage of ELDO B or C launch vehicles is presented. The engine has conventional turbopump feed system and arrangement, medium chamber pressure, conventional nozzle, constant thrust level, constant propellant mixture ratio, restart capability in space and minimum specific impulse of 425 sec. ESRO

N67-14290 Entwicklungsring Nord, Bremen (West Germany).
ELDO FUTURE PROGRAM STUDY 3.4 ON THE DEVELOPMENT OF AN O_2/H_2 ROCKET ENGINE

5 Apr. 1965 363 p refs Prepared for ELDO
(CFSTI: HC $7.00/MF $1.75

Presents preliminary designs for a liquid oxygen/liquid hydrogen propellant rocket engine. Gives detailed thermodynamic and structural design with the necessary test facilities and programs and outlines development schedules and costs. The engine is for use in an ELDO B launch vehicle. ESRO

N67-14300# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

REMARKS ON THE METHODS OF DETERMINATION OF THE VISCOSITY EFFECT IN PROPULSION NOZZLES [REMARQUES SUR LES METHODES DE CALCUL DES EFFETS DE LA VISCOSITE DANS LES TUYERES PROPULSIVES]

Pierre Carriere [1966] 44 p refs In FRENCH; ENGLISH summary Presented at the Ann. Joint Meeting DGRR/WGLR, Bad-Godesberg, W. Germany, 4–5 Oct. 1966 Submitted for Publication
(TIP-408) CFSTI: HC $2.00/MF $0.50

The present methods determination of the thrust and mass-flow rate of a supersonic nozzle without any internal separation are discussed and numerical results are given. The problem is much more complicated when there is a separation inside the nozzle due to, either the secondary flux effect (turbojet exhaust), or the external pressure effect (over-expanded nozzle). Research during the last few years has provided new (or improved existing methods) to determine these phenomena. The principle of these methods is exposed and a few examples are given. Author (ESRO)

N67-14305# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

RECENT RESULTS OBTAINED WITH HYBRID SYSTEMS OF LITHERGOLS [RESULTATS RECENTS OBTENUS SUR LES SYSTEMES HYBRIDES OU A LITHERGOLS]

Marcel Barrere and Andre Moutet [1966] 30 p refs In FRENCH Presented at the 17th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966 Submitted for Publication
(TP-395) CFSTI: HC $2.00/MF $0.50

Following a brief survey of previous results, the trends concerning the choice of the propellants are indicated. The various phases in the ignition are described and the methods used for the ignition of nonhypergolic or slightly hypergolic propellants are analyzed. The laws giving the regression rate, and obtained from laboratory apparatus or from actual engine runs, are discussed. The combustion modes in engines are described and three possible combustion models are presented. The combustion must be organized so that the regression rate is sufficient and the mixing of the propellants is as efficient as possible. There are low frequency instabilities for some operating conditions. Although thrust modulation is possible, it is difficult to obtain when a constant mixing ratio is desired during the modulation. Author (ESRO)

N67-14311# Bolkon Entwicklungen K. G., Munich (West Germany).

ELDO FUTURE PROGRAM PRELIMINARY STUDY NO. 1-1 SYSTEMS STUDY ABOUT AN APOGEE-IMPULSE-SYSTEM WITH LIQUID PROPELLANTS FOR THE ELDO-A LAUNCH VEHICLE

Feb. 1964 132 p refs Work performed for ELDO
(Bolkow-RF-12e) CFSTI: HC $4.00/MF $1.00

This paper discusses the technical feasibility of increasing the payload of the ELDO-A launch vehicle to give capability of launching a communications satellite in a polar orbit from Woomera. It presents design details and development costs for 5 possible apogee impulse systems, these include a spin-stabilized liquid propellant propulsion system, a liquid propellant propulsion system with attitude control and telemetry using the electronic system and equipment of the third stage, and an entirely autonomous fourth stage. Payload studies cover an attitude range from 5000–25000 km. ESRO

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N67-13578*# Consultants and Designers, Inc., Arlington, Va.

WAS THE MAGNETIC WAKE OBSERVED BY "IMP-1" LUNAR OR TERRESTRIAL [LUNNYY ILI ZEMNOY MAGNITNYY SLED NABLYUDAL IMP-1]

K. G. Ivanov 11 Nov. 1965 7 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 4, 1965 p 751–753
(Contract NAS5-3760)
(NASA-CR-80682; ST-PF-GM-10412) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Comparison of findings by preceding authors and the examination of ground and IMP-1 data, make it difficult to assume that IMP-1 crossed the lunar magnetosphere, whereas the ground data do not exclude the possibility that the magnetic wake of the earth, directed upward along the solar plasma flux, would contribute notably to phenomena observed on IMP-1 at sub-Alfvén flow past the earth's magnetosphere. Author

N67-13615# National Physical Lab., New Delhi (India).

ION KINETICS IN THE LOWER IONOSPHERE

A. P. Mitra and N. R. Mitra 15 Jul. 1966 38 p refs
(RPU-S28) CFSTI: HC $2.00/MF $0.50

A comprehensive reexamination is made of the ion kinetics of the lower ionosphere in the light of recent space measurements of solar X- and UV radiation, ion composition and electron density profiles, and laboratory measurements of rate constants. The ionic chemistries of the ions NO^+, O_2^+, N_2^+ and O^+ are discussed. An approach in terms of the individual ionic chemistries and the recognition of NO^+ abundance below 80 km, introduce some fundamental changes in the equations governing lower ionospheric ionization. Laboratory coefficients are found to be generally consistent with the data excepting for the process $N_2^+ + O_2 \rightarrow O_2^+ + N_2$. For the process $O_2^+ + N_2 \rightarrow NO^+ + NO$, for which laboratory observations give only an upper limit, a value of $1 \times 10^{-18} cm^3/s$ is inferred. A value of $3 \times 10^{-8} cm^3/s$ is obtained for the dissociative recombination coefficient of NO^+. Author

N67-13616 National Physical Lab., New Delhi (India).

AN UPPER ATMOSPHERIC MODEL FOR SOLAR MINIMUM CONDITION

V. P. Bhatnagar and A. P. Mitra 30 Jun. 1966 46 p refs
(RPU-S27) CFSTI: HC $2.00/MF $0.50

An atmospheric model for the height range 100–700 km, likely to hold for solar minimum conditions, was developed. The flux density of solar radiation at 10.7 cm wavelength is taken to be $70 \times 10^{-22} w/m^2/cps$. The model is based on extrapolation to 70 units, of density and density scale heights at different solar activity periods, in the height range of 250–700 km, deduced from drag observations of 40 satellites during the period 1958 to early 1964, for diurnal minimum

and maximum conditions. In the range of 100–250 km, density values obtained from various rocket flights till early 1964 were used. The model gives the distribution of neutral particles, i.e., $n(O_2)$, $n(N_2)$, n(O), n(He), n(H); atmospheric scale height, mean molecular mass, atmospheric scale height, mean molecular mass, atmospheric temperature, and atmospheric pressure with height up to 700 km. Diffusive equilibrium for N_2, O_2 and O has been assumed to hold above 130 km, for He above 100 km, and for H above 500 km. In the region of dissociation, observed values of $n(O)/n(O_2)$ were adopted. The results are discussed and compared with those given by other workers. Author

N67-13810# Paris Observatory, Meudon (France). Astrophysics Section.
SYNOPTIC MAPS OF THE SOLAR CHROMOSPHERE AND FILAMENT AND ACTIVITY CENTER CATALOGUES, VOLUME IV, NO. IV, 1964–1965 [CARTES SYNOPTIQUES DE LA CHROMOSPHERE SOLAIRE ET CATALOGUES DES FILAMENTS ET DES CENTRES D'ACTIVITE, VOLUME IV, FASCICULE IV, 1964–1965]
1966 81 p In FRENCH Supported in part by UNESCO
CFSTI: HC $3.00/MF $0.75

Solar chromosphere data for the period January 3, 1965 to December 13, 1965, are presented on 26 synoptic maps. Details are also given on filaments and centers of activity observed during this period. The conventions and symbols adopted to represent these phenomena are the same as in the first volume of this type. Included in the solar rotation charts are details on height, mean coordinates, and rotations of partial and total visibility. Transl. by R.U.

N67-13815# National Physical Lab., New Delhi (India).
SOME RESULTS OF ELECTRON CONTENT MEASUREMENTS AT DELHI FROM FARADAY FADING OF S-66 TRANSMISSIONS
Tuhi Ram Tyagi and Y. V. Somayajulu 15 Jun. 1966 32 p refs
(RPU-S26; SR&RA-6; SR-26) CFSTI: HC $2.00/MF $0.50

This paper contains the results of an analysis of total electron content (I_s) measurements made from the recordings of Faraday fading rotation at Delhi of the 20 and 40 Mc/s transmissions of the satellite Explorer-22 (S-66) for the period October, 1964 through June, 1965, the period of low solar activity. The results show that the diurnal maximum is reached around 13–14 hrs, while at night the electron content falls to low values decreasing slowly with time until 06 hrs when it starts to increase. The ratio I_{smax}/I_{smin} increases from 7 for Oct.–Dec. '64 through 10 for Jan.–Mar. '65 to about 25 for Apr.–Jun. '65. The dependence of I_s on magnetic activity shows that there is positive correlation during daytime while nighttime values do not show any dependence on magnetic activity. In addition, the electron content seems to have a correlation with solar zenith angle. Author

N67-13870# Pennsylvania State Univ., University Park. Dept. of Astronomy.
SOLAR RADIO FLUX DURING THE IQSY AT UNIVERSITY PARK, PENNSYLVANIA, APRIL–JUNE 1966
John P. Hagen Oct. 1966 32 p
(Grant NSF GP-2986)
(SR-006)

This report contains solar radio flux data recorded at 10,700 Mc/s, 2,700 Mc/s, 960 Mc/s and 328 Mc/s during the quarter 1 April 1966 to 30 June 1966. A table of distinct events is also given. Author

N67-14142# High Altitude Observatory, Boulder, Colo.
THE DAILY FLARE INDEX, I_f FOR JULY 1955–DECEMBER 1961
Constance B. Sawyer (ESSA, Boulder, Colo.) 20 Oct. 1966 9 p /ts IGY Solar Activity Rept. Ser. No. 35

Tabulations and plots of the daily index of solar flare activity are presented, and methods of computation are briefly outlined. L.E.W.

N67-14177*# Consultants and Designers, Inc., Arlington, Va.
ON THE INTERVENING ROLE OF THE MAGNETIC FIELDS OF SOLAR CORPUSCULAR STREAMS IN THE DETERMINATION OF THE DEGREE OF THEIR GEOEFFECTIVENESS [O POSREDNICHESKOY ROLI MAGNITNYKH POLEY SOLNECHNYKH KORPUSKULYARNYKH POTOKOV V OPREDELENII STEPENI IKH GEOEFFEKTIVNOSTI]
I. A. Zhulin 6 Jun. 1966 5 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 2, 1966 p 375–376
(Contract NAS5-9299)
(NASA-CR-80819; ST-SP-GM-10497) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The influence of the magnetic fields of solar corpuscular streams on the character of stream interaction with the earth's magnetosphere is discussed. Particular attention is given to the question of the impossibility of the stream's magnetic field penetration inside the magnetosphere and of the requirement of magnetohydrodynamic treatment of the theory of geomagnetic disturbances. The intermediate role of the stream's magnetic field in the interaction with the magnetosphere of the incident plasma was previously brought forth as one of the possible mechanisms determining the geoeffectiveness of corpuscular streams. This note constitutes a complement to this work, somewhat concretizing the indicated case. Author

N67-14199# European Space Research Organization, Paris (France).
ELECTROMAGNETIC RADIATION IN SPACE
Sep. 1966 372 p refs Proc. of 3d ESRO Summer School, Alpbach, Austria, 1965
(ESRO-SP-6) CFSTI: HC $7.00/MF $1.50

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11. CELESTIAL GAMMA-RAYS: OBSERVATIONAL ASPECTS G. W. Hutchinson (Southampton Univ.) 20 p refs

12. THEORETICAL ASPECTS OF SOLAR X-RADIATION C. De Jager (Sterrewacht Sonnenborg) 27 p refs

13. OBSERVATIONS OF SOLAR X-RAYS J. Labeyrie (Commissariat a l'Energie Atomique) 62 p refs

14. SOME UNRESOLVED PROBLEMS IN THE CORPUSCULAR COSMIC RADIATION B. Peters (Copenhagen Univ.) 19 p refs

15. OVERALL CONCEPT OF THE ESRO ASTRONOMICAL SATELLITE L. A. Hussin (European Space Tech. Centre) 27 p refs

16. EXPERIMENTAL OBSERVATIONS OF PRIMARY COSMIC-RAY ELECTRONS L. Scarsi (Milan Univ.) 28 p refs

17. SOLAR XUV OBSERVATIONS FROM STABILISED SKYLARK ROCKETS R. Wilson (Culham Lab.) 15 p refs

N67-14288# European Space Research Lab., Noordwijk (Netherlands).

SOLAR ECLIPSE OF 20 MAY 1966: CENTAUR SOUNDING ROCKET EXPERIMENTS

W. de Graaff Paris, ESRO, May 1966 21 p refs

(ESRO-SN-56) CFSTI: HC $1.00/MF $0.50

Three of the experiments were designed to measure the change in intensity of solar electromagnetic radiation in various wavelength regions. They comprise: a measurement of the chromospheric continuum near 1500 and 1800 Å by means of a grating monochromator and a photomultiplier; a measurement of the Lyman-alpha radiation, by means of an ionization chamber; a measurement of the soft X-ray intensity of the sun, with the aid of proportional counters. The fourth experiment, designed to measure the influence of these changes on the state of the ionosphere, is a measurement of the electron temperature between 100 and 120 km by means of a Langmuir probe. Author (ESRO)

N67-14298# Royal Inst. of Tech., Stockholm (Sweden). Electron and Plasma Physics Div.

CURRENTS IN THE SOLAR ATMOSPHERE AND A THEORY OF SOLAR FLARES

H. Alfven and P. Carlqvist 13 Oct. 1966 16 p refs

(Rept.-66-16) CFSTI: HC $1.00/MF $0.50

Progress in the knowledge of solar electromagnetic conditions has recently been made by Severny who has mapped vertical currents near the centre of the solar disk. The observational technique has given the possibility to describe the electromagnetic state by currents instead of magnetic fields. This paper gives a survey of the advantages of the current description for a better understanding of the theory of solar flares. It reviews current interruption, maximum current through a plasma, the disruption of current and leads finally to the qualitative picture of a solar flare. ESRO

N67-14329# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE FLOWS OF SOLAR PLASMA ON INTERPLANETARY STATION ZOND-2

V. V. Bezrukikh, K. I. Gringauz et al 25 Apr. 1966 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 163, no. 4, 1965 p 873–876

(FTD-TT-1946; TT-66-62412; AD-640247) CFSTI: HC $1.00/MF $0.50

On the interplanetary station Zond-2 launched November 30, 1964, there were mounted several traps of charged particles intended for measurements of flows of charged particles close to the Earth and the determination of the magnitude of the flows of the solar plasma and their energy spectra. In this report there are presented preliminary data of measurements effected on the station Zond-2 with the aid of a modulation trap and one of the integral traps of charged particles in the course of the first half of December 1964. Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N67-13410# Academy of Sciences (USSR), Moscow.

COMMUNICATIONS FOR THE SYMPOSIUM ON THE NON-STABLE STARS

1955 203 p refs In RUSSIAN and ENGLISH Presented at the IX Gen. Assembly of the Intern. Astron. Union, Dublin, 1955

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1. STARS OF T TAURI AND UV CETI TYPES AND THE PHENOMENON OF CONTINUOUS EMISSION V. A. Ambartsumian p 20–37 refs (See N67-13411 04-30)

2. ON THE ATMOSPHERES OF THE WOLF-RAYET STARS B. A. Vorontsov-Velyaminov p 38–49 (See N67-13412 04-30)

3. SUBSYSTEM OF NOVAE I. M. Kopylov p 50–67 refs (See N67-13413 04-30)

4. NON-STABILITY IN CLOSE BINARY STARS V. A. Krat p 68–84 refs (See N67-13414 04-30)

5. VARIABLE STARS AND PROBLEMS OF STELLAR FORMATION B. V. Kukarkin p 85–100 refs (See N67-13415 04-30)

6. PHENOMENA OF NON-STABILITY IN CLOSE BINARY SYSTEMS D. J. Martynov p 101–129 refs (See N67-13416 04-30)

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8. IRREGULAR VARIABLE STARS OF THE RW AURIGAE TYPE P. N. Kholopov p 165–187 refs (See N67-13418 04-30)

9. THE TWO-LAYER STARS V. P. Tsesevitch p 188–195 refs (See N67-13419 04-30)

N67-13411# Academy of Sciences (USSR), Moscow.

STARS OF T TAURI AND UV CETI TYPES AND THE PHENOMENON OF CONTINUOUS EMISSION

V. A. Ambartsumian *In its* Commun. for the Symp. on the Non-stable Stars 1955 p 20–37 refs (See N67-13410 04-30)

Suggestions regarding the causes of nonstability of the T-Tauri and UV Ceti stars are presented. The physical phenomena of these two types of stars are compared, and representatives of each group are discussed. Continuous emission is described as the most important feature connecting the two classes of variable stars. The possibility of continuous emission appearing as a consequence of an increase of temperature of the external layers is considered. Four species of T-Tauri stars are discussed to provide a clearer understanding of their processes. It is stated that the liberation of large amounts of energy in the outer parts of the T-Tauri stars and also in the outer layers of their atmospheres may be considered as the physical cause of the processes going on in these stars. S.P.

N67-13412# Academy of Sciences (USSR), Moscow.

ON THE ATMOSPHERES OF THE WOLF–RAYET STARS

B. A. Vorontsov-Velyaminov *In its* Commun. for the Symp. on the Non-Stable Stars 1955 p 38–49 (See N67-13410 04-30)

Various hypotheses explaining the phenomena displayed by the Wolf–Rayet spectra are discussed and evaluated. The hypothesis of outflow of matter is considered with respect to difficulties arising from the very large radii for the Wolf–Rayet atmospheres. A means of accounting for the observed large width of the Wolf–Rayet bands is suggested. S.P.

N67-13413# Academy of Sciences (USSR), Moscow.
SUBSYSTEM OF NOVAE
I. M. Kopylov *In its* Commun. for the Symp. on the Non-Stable Stars 1955 p 50–67 refs (See N67-13410 04-30)

In order to study the cause of the nova outburst, a number of properties and peculiarities are investigated. The absolute magnitudes for the light maxima and minima are examined to answer questions concerning the physical properties of novae. Next, the temperatures, the light curves and their variations, and the position of the novae on the Russell diagram are considered. Finally, the spatial distribution of the novae in the galaxy and their relations with supernovae, nova-like stars, and nuclei of planetary nebulae are investigated. S.P.

N67-13414# Academy of Sciences (USSR), Moscow.
NON-STABILITY IN CLOSE BINARY STARS
V. A. Krat *In its* Commun. for the Symp. on the Non-Stable Stars 1955 p 68–84 refs (See N67-13410 04-30)

Unstable stars, which compose eclipsing binaries, are studied to obtain information concerning their physical properties and the mechanism of the ejection of gases from the atmospheres of the components. The stage of instability is discussed with respect to evolution of a star. The enormous inertia of the luminosity of a star is considered the cause of disturbance to the equilibrium of the gaseous masses near the surface. A new cosmogonical interpretation of the H–R diagram, based on data obtained from studies of eclipsing variables, is presented. Finally, it is suggested that the instability of a star indicates its comparatively old age rather than its youth, and that instability can arise at various stages of stellar evolution. S.P.

N67-13415# Academy of Sciences (USSR), Moscow.
VARIABLE STARS AND PROBLEMS OF STELLAR FORMATION
B. V. Kukarkin *In its* Commun. for the Symp. on the Non-Stable Stars 1955 p 85–100 refs (See N67-13410 04-30)

Variable stars are discussed to illustrate that similar stages in stellar evolution are observed in different systems and in various parts of complex stellar systems. The Mira Ceti type stars are used as an example because of their brightness and large variations. Especially noted is the emission spectrum, and it is suggested that Mira Ceti stars are of recent origin. S.P.

N67-13416# Academy of Sciences (USSR), Moscow.
PHENOMENA OF NON-STABILITY IN CLOSE BINARY SYSTEMS
D. J. Martynov *In its* Commun. for the Symp. on the Non-Stable Stars 1955 p 101–129 refs (See N67-13410 04-30)

Various types of instability in binary systems, especially the eclipsing variables, are described. Instability is attributed to (a) physical variability of one or two components, (b) the presence of emission bands or lines in spectra in phases of orbital motion, (c) sharp differences between the spectral and photometrical elements of the system caused by gaseous streams where the absorption lines are originating, and (d) unsteadiness of the orbital motion period. The so-called "Kuiper–Struve mechanism" for the explanation of instability in close binary systems is discussed. The hypothesis of ejection of matter is used to explain irregular changes in the duration of the orbital period of a binary system. S.P.

N67-13417# Academy of Sciences (USSR), Moscow.
PHYSICAL PROCESSES IN NOVAE
E. R. Mustel *In its* Commun. for the Symp. on the Non-Stable Stars 1955 p 130–164 refs (See N67-13410 04-30)

Problems presented by the interpretation of spectroscopic phenomena observed during the outbursts of novae are discussed. Equations are given for the expansion of the photosphere and the reversing layer of a nova, and the moment of light maximum is described as an important transitional stage in its evolution. Two hypotheses are introduced to explain the existence of light maximum and the appreciable changes in the spectrum of the star. Other nongravitational forces are considered, and the question of origin of novae outbursts is also examined. S.P.

N67-13418# Academy of Sciences (USSR), Moscow.
IRREGULAR VARIABLE STARS OF THE RW AURIGAE TYPE
P. N. Kholopov *In its* Commun. for the Symp. on the Non-Stable Stars 1955 p 165–187 refs (See N67-13410 04-03)

The RW Aurigae type of irregular variable stars belonging to the spectral class G and showing extremely rapid and large variations of brightness are discussed. Such stars are often called the Orion nebula type variables, because a numerous group of irregular variables consisting of not less than 220 members is connected with this nebula. These T-Tauri variable stars are said to have the following common features: irregular variations of brightness with amplitudes about 3^m, spectra similar to that of the solar chromosphere, low luminosity, and connection with a dark or bright nebula. S.P.

N67-13419# Academy of Sciences (USSR), Moscow.
THE TWO-LAYER STARS [LES ETOILES A DEUX COUCHES]
V. P. Tsesevitch *In its* Commun. for the Symp. on the Non-Stable Stars 1955 p 188–195 refs In FRENCH (See N67-13410 04-30)

Some characteristics of double-layer giant stars are reviewed. A comparison of star brightness curves with the indexes of color and radial velocities revealed certain spectral properties common to all stars examined. Conclusions indicate that rapid variations in brightness arise from the different layers of the photosphere surrounding the star, and that the perturbation leading to a new cycle of variations begins at the base of the photosphere. Summarized results are given for the slow variations of RV Tau-type stars, and the typical structure is briefly analyzed. These data are applicable to the properties of Cepheids. Transl. by R.Ll.

N67-13497# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR SLOPE ANGLES AND SURFACE ROUGHNESS FROM RANGER PHOTOGRAPHS
Raoul Choate *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 411–432 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50
(Contract NAS7-100)

Error in the estimates of large slope angles of lunar craters due to the interpretation of the dark areas in the craters in photographic prints as shadows are discussed. Recent work has demonstrated that most slopes in the Ranger impact areas have small angles. Most craters have uniform slopes with a short, nearly horizontal central portion and gently rounded rims, i.e., they have slightly modified conical cross sections. The angle of repose of lunar material as measured from maximum slope angle of talus-like slopes is probably 33° to 35°. Slope angle, local relief, and surface roughness measurements indicate that the topography in the impact areas of Rangers 7, 8, and 9 probably developed from the same geomorphic processes and is at or near equilibrium. K.W.

N67-13502# Barringer Research, Inc., Natick, Mass.
STUDIES OF THE RADAR PROPERTIES OF ROCKS IN VACUUM AND THE DESIGN OF A SPECIALIZED RADAR FOR MEASURING STRATIFICATION FEATURES OF THE LUNAR AND TERRESTRIAL SURFACE
D. W. Holdsworth and A. R. Barringer *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 474–487 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Very high frequency radar techniques were used to detect and map subsurface discontinuities such as soil layering, rock interfaces, and such discrete bodies as ore deposits in lunar and other planetary surfaces. Experiments were carried out using various materials that might be expected to be similar to lunar rocks and soils. These materials were crushed to various sizes and measured under extremely dry and vacuum dried conditions. The loss tangents, dielectric constants, and reflectivities were measured. Experimental results substantiate the case for sounding the lunar surface in the same manner as the present sounding of polar ice caps. S.P.

N67-13530*# Volt Technical Corp., Washington, D. C.
CONCERNING THE SERIES OF WORKS BY R. VERNIC ON THE REGULARIZATION AND THE PERIODICAL SOLUTIONS OF THE PROBLEM OF THREE BODIES
G. A. Merman 5 Dec. 1966 11 p refs Transl. into ENGLISH from Byul. Teor. Astron. (Moscow), v. 6, no. 6 (70), 1956 p 408–415
(Contract NAS5-12487)
(NASA-CR-80610; ST-CM-10543) CFSTI: HC $1.00/MF $0.50 CSCL 03C

An attempt is made to demonstrate the inconsistency of assertions pertaining to the regularization and the periodical solutions of the problem of three bodies. Consideration is given to the theorem concerning transformation of the independent variable which fully eliminates all the singular points of the three-body problem solution over the entire complex plane. The assertion about the nonexistence of periodical solutions of the three-body problem, other than the Lagrange solutions, is demonstrated to be erroneous. S.P.

N67-13573*# Volt Technical Corp., Washington, D. C.
A PROPOS THE SERIES OF WORKS BY K. VERNIC ON THE REGULARIZATION AND THE PERIODICAL SOLUTIONS OF THE PROBLEM OF THREE BODIES
G. A. Merman 5 Dec. 1966 11 p refs Transl. into ENGLISH from Byul. Teor. Astron. (USSR), v. 6, no. 6, 1956 p 408–415
(Contract NAS5-12487)
(NASA-CR-80687; ST-CM-10543) CFSTI: HC $1.00/MF $0.50 CSCL 03C

The previously published assertions on the three-body problem solutions are discussed. The inherent inconsistency is described for the theorems: (1) the transformation of the independent variable fully eliminates all the singular points of the solution of the problem over the entire complex plane, and (2) the Lagrange solutions are the unique periodical solutions of the general three-body problem. It is concluded that the Vernic transformation regularizes only double collisions, and that periodical solutions other than Lagrange's are possible. N.E.N.

N67-13579*# Volt Technical Corp., Washington, D. C.
ON THE POWERFUL X-RAY EMISSION OF RADIOGALAXIES [O MOSHCHNOM RENTGENOVOSKOM IZLUCHENII RADIOGALAKTIK]
V. L. Ginzburg 30 Nov. 1966 17 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 89, no. 4, 1966 p 549–562
(Contract NAS5-12487)
(NASA-CR-80681; ST-IGA-10541) CFSTI: HC $1.00/MF $0.50 CSCL 03A

The growth of X-ray astronomy is briefly reviewed, and X-ray sources are described. Tables of X-ray sources are included, and bremmstrahlung emission is discussed. The nature of cosmic X-radiation is emphasized, and the need for more satellite observations is indicated. N.E.N.

N67-13612# Library of Congress, Washington, D. C. Aerospace Technology Div.
ON OPTIMIZING A TRAJECTORY TAKING INTO ACCOUNT THE MOTION ABOUT THE CENTER OF MASS Translations of Foreign Scientific and Technical Literature [TAKABAYEV, M. K. OB OPTIMIZATSII TRAYEKTORII C UCHETOM DVIZHENIYA VOKRUG TSENTRA MASS]
Andrew V. Valiunas 29 Jul. 1966 13 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), v. 2, no. 7, 1965
(ATD-66-91)

Consideration is given to the problem of the optimum programming of power plant thrust for the linear motion of a variable mass body in a resisting medium. It is assumed that the body is in oscillatory motion around the center of mass under the effect of aerodynamic moments. Previous data dealing with the problem of optimal programming for various aircraft are cited; in these studies, the aircraft is regarded as a point of variable mass, i.e., it is considered only as the motion of the center of mass. Using these results, all necessary conditions are derived, and the uniqueness of optimal thrust is proven. M.G.J.

N67-13642# Academy of Sciences of the Armenian SSR, Erevan (USSR). Byurakonskaya Astrophysical Observatory.
ON THE PROBABILITY OF CAPTURE IN THE THREE BODY PROBLEM [O VEROYATNOSTI ZAKHVATA V ZADACHE TREKH TEL]
R. A. Saakyan 1961 58 p refs In RUSSIAN
CFSTI: HC $3.00/MF $0.50

Results are presented of work showing that capture in the three-body problem depends on the vector and on greater accuracy in the combination of two-body crossings of remote binary systems. The probability of formation of binary systems by means of capture is from excellent to zero, depending on the distance between components, mass, participation in triplet star formation, and on the velocity of the stars within the stellar system. The coefficients of probability in the formation of binary stars by means of capture or disintegration indicate that binary stars within our galaxies are not formed by capture and that capture plays here no role whatever.
Transl. by K.W.

N67-13662*# Bern Univ. (Switzerland). Physikalisches Institut.
STUDIES ON THE RADIOACTIVE DATING OF THE LUNAR SURFACE Final Report
P. Eberhardt and J. Geiss Aug. 1966 15 p refs
(Grant NaG-157-61)
(NASA-CR-80730) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The feasibility of remote-controlled rare gas analysis was investigated in an effort to develop a simple, lightweight, rugged rare gas extraction and purification system with negligible external power consumption. A high-temperature extraction system with a chemical reaction as a heat source was examined. Thermite, a mixture of iron oxide and aluminum, was used as the energy source. Temperatures higher than 1500°C were

reached, and the heat of solidification of the molten iron prolonged the period of time the sample was at high temperature. A molybdenum extraction crucible lined with titanium sponge and containing a graphite liner was used. Total weight of the system is less than 500 g, the diameter is 7 cm, and the length is 13 cm. Performance of the extraction system is discussed. K.W.

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N67-13678*# California Univ., San Diego.

THE NATURE OF THE QUASI-STELLAR OBJECTS

Geoffrey Burbidge [1966] 11 p ref Submitted for Publication (Grant NsG-357)

(NASA-CR-80679) CFSTI: HC $1.00/MF $0.50 CSCL 03B

An account of the properties of the quasi-stellar objects (QSO's) with special bearings on the question of whether they are local or cosmological objects is presented. The fact that only redshifts have been observed thus far is discussed and interpreted in several ways. Treated in addition are luminosities and radio fluxes, variations in flux, absorption features, composition and distribution of QSO's, and the log N-log S curve. The author submits that the idea of the QSO's being local objects cannot easily be dismissed. K.W.

N67-13727*# Princeton Univ., N. J.

ASTRONOMICAL PHOTOGRAPHY FROM THE STRATOSPHERE

Martin Schwarzchild Washington, Smithsonian Institution, 1964 10 p Presented as the 28th Ann James Arthur Lecture, 8 May 1962

(Grant NsG-69)

(NASA-CR-80742; Publ.-4573) CFSTI: HC $1.00/MF $0.50 CSCL 03A

A discussion is presented on Project Stratoscope which involved sending a telescope into the stratosphere on a balloon to obtain high definition photographs of sample areas of the solar surface, in particular of the detailed structure of the convective elements in the solar granulation. The telescope, its development, test flights, results, and a later flight to photograph Mars are described. R.N.A.

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N67-13786*# National Aeronautics and Space Administration, Washington, D. C.

A GEOMETRICAL METHOD FOR DETERMINING THE PARAMETERS OF MOTION OF SPACECRAFT IN A NEWTONIAN FIELD OF FORCE [GEOMETRICHESKIY METOD OPREDLENIYA PARAMETROV DVIZHENIYA APPARATOV V N'YUTONOVSKOM POLE SIL]

G. V. Mozhayev Dec. 1966 12 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 5, no. 6, 1965 p 1103–1109

(NASA-TT-F-10459) CFSTI: HC $1.00/MF $0.50 CSCL 22C

A method is proposed for determining the parameters of motion using geometrical constructions based on the properties of a velocity hodograph. With this method it is possible to derive analytical solutions which are difficult to obtain using classic integrals. Author

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N67-13845 Royal Armament Research and Development Establishment, Fort Halstead (England).

INTERACTION OF ROCKETS AND SATELLITES WITH THE IONOSPHERE

R. N. Cox and W. A. Clayden *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. I 1966 p 63–74 refs (See N67-13842 04-12)

The re-distribution of charged particles about a body flying in the ionosphere can have a large influence on electromagnetic wave propagation in the region of the body and on the interpretation of probes mounted on the body. Three distinct flow regions are noted which depend upon the relative sizes of the charged particle and neutral mean free paths and a typical body dimension. The qualitative nature of the flow in these regions is discussed and some laboratory experiments which simulate certain aspects of the three flow regions are described. In these experiments Langmuir probes were used to measure the redistribution of charged particles about spheres, discs, wires and jets. Author

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N67-13850 Lockheed Missiles and Space Co., Sunnyvale, Calif. Space Programs Div.

REVIEW OF THE INFLUENCE OF SPACE ENVIRONMENT UPON VEHICLE COMPONENTS

Ronald Smelt *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. I 1966 p 141–165 refs (See N67-13842 04-12)

The paper concentrates upon problems which have been encountered in space vehicles up to the present, as a result of environment. Much of the information has been obtained by practical experience of operations of Agena satellites, supported by laboratory work in specific areas. Outgassing in the high vacuum of space was observed in the earliest artificial satellites by its influence upon the internal pressures and upon the over-all satellite behavior as evidenced by temperature history and orientation. Work has also concentrated on the problem of lubrication of bearing surfaces in space over long periods, arising from the evaporation of conventional lubricants. The paper summarizes experience and investigations in these areas, together with work on attempted solutions of difficulties. Vehicle problems presented by the multiple sources of space radiation are also reviewed, with emphasis on the resulting deterioration of surface properties. There is also some experience, from satellite flights, of the hazards presented by high-energy radiation from solar flares and its influence on internal components of space vehicles. Another area of potential hazard, from encounters with meteorites, is discussed, and experimental programs to evaluate possible damage are reviewed. Finally, it is emphasized that the influence of space environment is not entirely unfavorable; the paper mentions some factors which may help the space vehicle designer to achieve satisfactory operation for long durations in space. Author

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N67-13853* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ELECTRIC DRAG ON SATELLITES—THEORY AND EXPERIMENT

William C. Pitts and Earl D. Knechtel *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. I 1966 p 211–221 refs (See N67-13842 04-12)

Laboratory measurements of electric drag of spherical satellites with conducting surfaces are compared with existing theories. Theories that neglect the shielding effect of the plasma sheath predict high values of electric drag, and theories that neglect the hard collisions of ions predict low values of electric drag. From the theory that is most consistent with the experimental data, three scaling parameters are developed that permit the extension of the laboratory results to realistic satellite conditions. For example, a typical laboratory test condition corresponds to a 52-cm diameter satellite at about 1000 km altitude. It is found from both the theory and the experimental data that for most satellites, only the ions which impinge on the satellite surface contribute appreciably to the electric drag. This latter result is used to develop a simple empirical relation that permits rapid estimation of electric drag for spherical satellites over the practical ranges of interest. Author

N67-13866# Cincinnati Univ., Ohio.
OUTLINE OF A THEORY OF NON-PERIODIC MOTIONS IN THE NEIGHBORHOOD OF THE LONG-PERIOD LIBRATIONS ABOUT THE EQUILATERAL POINTS OF THE RESTRICTED PROBLEM OF THREE BODIES
E. Rabe [1966] 22 p refs

Solutions are presented for the computation of nonperiodic trajectories. The computations have been limited to the Trojan problem because of the greater simplicity of these motions which are based on the relatively small mass ratio Jupiter/sun. It is noted that the principle advantage of this theory lies in the ready availability of completely rigorous periodic reference orbits, which should eliminate at the outset a great deal of work required in previous methods. A.G.O.

N67-13957# Naval Research Lab., Washington, D. C.
SIMPLIFIED PREDICTION EQUATIONS FOR THE NRL SATELLITE POSITION DISPLAY Interim Report
R. J. Orsino and T. L. Francavilla 4 Aug. 1966 34 p refs
(NRL-6396; AD-639692)

A satellite position prediction and display equipment (SPAD) has been conceived and developed at NRL. Details regarding the operation and performance of the equipment have been described previously (AD-622 198). The present report concerns itself primarily with the equations utilized in a digital computer for performing the position prediction computations. With periodically updated orbital elements for each satellite stored in the computer memory, these equations provide position coordinates and height above the earth's surface for any satellite, at any desired time. Restricted by the limited computer speed and memory space available, the equations arrived at, in order to both satisfy the display system requirements and to meet the desired accuracy, are of a degree of complexity which places them between the basic planetary equations of celestial bodies and the much more sophisticated equations of today's space computer centers. Although modifications of the basic equations have previously been developed and reported in AD-266 596 and AD-264 949, they were successful in computing positions of only those satellites whose orbits are relatively stable. The equations of the report, which are extensions of these modified equations, are able to provide geocentric coordinate positions for those unstable satellites whose orbits are decaying rapidly. This extension is accomplished by including the time rate of change of the semimajor axis as an input orbital element and by the manner in which the period is computed. TAB

N67-13960# Royal Aircraft Establishment, Farnborough (England).
THE LARGE SEMI-ANNUAL VARIATION IN EXOSPHERIC DENSITY: A POSSIBLE EXPLANATION
G. E. Cook Jul. 1966 12 p refs
(RAE-TR-66211) CFSTI: HC $1.00/MF $0.50

Analysis of the orbit of the satellite Calsphere 1 confirms the large semiannual variation in density at heights near 1100 km previously found from the orbit of Echo 2, and not predicted by present atmospheric models. This variation is probably due to relatively smaller variations at much lower altitudes, in particular variations at heights near 120 km, which is taken as the lower boundary for the construction of upper-atmosphere models. Author

N67-14100*# Israel Program for Scientific Translations, Ltd., Jerusalem.
SPACECRAFT NAVIGATION
L. M. Vorob'ev 1966 159 p refs Transl. into ENGLISH of the book "Navigatsiya Kosmicheskikh Korablei" Moscow, Voennoe Izd. Min. Oborony SSSR, 1964 Published for NASA and NSF
(NASA-TT-F-334; TT-66-51024) CFSTI: HC $5.00/MF $1.00 CSCL 22A

A popular exposition of the fundamental problems in space vehicle navigation is presented. The galaxies and solar system are described, along with the difficulties likely to be encountered. Celestial mechanics is discussed emphasizing trajectories of spacecraft. Details are given on the basic problems of space navigation and methods of solution. N.E.N.

N67-14187 Royal Greenwich Observatory, Herstmonceux (England).
FABRY PHOTOMETRY OF BRIGHT SOUTHERN STARS
A. W. J. Cousins London, HMSO, 1966 69 p refs *In* Bull. No. 122
HMSO: 9s

An account is given of the first Cape 'Bright Star Program' observed with a Fabry photometer. The resulting photographic magnitudes, reduced to the S'Pg system, are given in Table II. These magnitudes have average external standard errors of $\pm 0^m.012$. The table also gives V magnitudes derived from S'Pg with the help of accurate values of B–V. These V magnitudes have average external standard errors of $\pm 0^m.014$. Individual observations of variable stars are given in an appendix. This list is not restricted to observations made with the Fabry photometer but includes nearly all photoelectric observations of variable stars in table II made at the Cape up to 1965. Author

N67-14201*# Auburn Univ., Ala.
A METHOD FOR DETERMINING OPTIMUM RE-ENTRY TRAJECTORIES
William F. Reiter, Grady R. Harmon, and Joe W. Reece Jun. 1966 95 p refs
(Grant NGR-01-003-008)
(NASA-CR-80842) CFSTI: HC $3.00/MF $0.75 CSCL 22C

The Pontryagin maximum principle is used to formulate the problem of finding optimum atmospheric vehicular reentry trajectories. The optimization problem is that of minimizing an integral which is a function of the state and control variables. The vehicle's motion is assumed to be influenced only by a gravitational force and an aerodynamic force. The problem is formulated and the necesary equations are developed simultaneously for three sets of Euler angles. Computational procedures are suggested so that numerical trajectories may be generated. Author

N67-14206*# Massachusetts Inst. of Tech., Cambridge.
ON THE SPIRAL PATTERNS IN DISK GALAXIES
C. C. Lin [1966] 14 p refs
(Grant NSG-496)
(NASA-CR-80837) CFSTI: HC $1.00/MF $0.50 CSCL 03B

A discussion is presented concerning the behavior of a galaxy of stars similar to the Milky Way, with emphasis on the mechanism through which the regular spiral pattern is created and maintained. The discussion concludes that the spiral patterns in disk-like galaxies can be satisfactorily explained in terms of density waves which are the collective modes of the stellar system analogous to plasma waves. R.N.A.

N67-14235*# Israel Program for Scientific Translations, Ltd., Jerusalem.
FIVE YEARS OF SOVIET SPACE RESEARCH
M. G. Kroshkin and V. G. Samarin *In its* Geophys. Bull., No. 13 1966 p 86–100 refs (See N67-14221 04-13) CFSTI: HC $4.00/MF $1.00

Research objectives and accomplishments of the various Soviet spacecraft are summarized, and tables are given to illustrate such information as initial orbital data, date of launching, weight, duration of flight, number of revolutions around the earth, and distance travelled by the Soviet artificial earth satellites, space rockets, automatic interplanetary stations, and satellite-spaceships (1957 to 1962). L.E.W.

N67-14250*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LUNAR STAY TIME EXTENSION MODULE
Charles I. Tynan, Jr. *In its* Selected Papers on Environ. and Attitude Control of Manned Spacecraft Dec. 1966 p 67–77 (See N67-14243 04-31) CFSTI: HC $2.50/MF $0.75

A contractual and inhouse research effort to develop the technology for extending man's stay time on the lunar surface is discussed. Parameters such as lunar environment, crew size, stay time, mission objectives, and integration with logistic vehicles have been considered with respect to their effect on the configuration and design of expandable modules and supporting subsystems. An expandable lunar shelter, referred to as a stay time extension module, has been designed and a full-scale laboratory model of the shelter is being fabricated. The shelter structure, subsystems, and expendables to support 2 men on the lunar surface for 8 days should weigh 1,276 pounds and be capable of being packaged in canisters attached to the base of a manned lunar excursion module for transportation to the lunar surface. Test programs to be conducted with the full-scale shelter model and samples of its wall structure should make significant contributions to the advancement of expandable structures technology for lunar shelters and other space structures applications. Author

N67-14263*# IIT Research Inst., Chicago, Ill.
A SURVEY OF MISSIONS TO SATURN, URANUS, NEPTUNE, AND PLUTO
F. Narin, comp. Oct. 1966 142 p refs
(Contract NASr-65(06))
(NASA-CR-80848; IITRI-M11) CFSTI: HC $4.00/MF $1.00 CSCL 22A

Potential missions to Saturn, Uranus, Neptune, and Pluto are considered technically feasible; and flight times range from 1 to 3 years for Saturn to a minimum of 4 years for Pluto with a nuclear electric low thrust stage. For 600 to 2000 lb Saturn V-Centaur and Saturn IB-Centaur loose orbiters to Saturn, Uranus, and Neptune, flight times are considered to range from 2.5 to 10 years. In years when possible, a gravity assist flight mode should be used for flyby missions; in years when gravity assist is not possible or if guidance requirements are too high for gravity-assisted flights, direct ballistic flights will be satisfactory. Missions to each of the planets could be quite similar, and a basic payload of 85 lb and a total payload of about 1000 lb can be used. Guidance requirements for flyby missions are considered within present state-of-the-art; and for initial flyby flights, a miss distance of 3 or more planet radii, with an uncertainty of one planet radius, appears satisfactory. An extensive program of flyby flights is not recommended because such results are limited to comparisons with orbiter data. M.W.R.

N67-14256*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR PROPERTIES OF THE MOON
Tor Hagfors [1966] 12 p refs
(Contract NSR-22-009-106)
(NASA-CR-80849) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Radar methods applied to the study of the lunar surface are reviewed, and it is noted that obtained radar data indicate a porous, undulating surface strewn with rock-like structures. The rayed craters are considered to be both rougher and denser than their surroundings. It is concluded that detailed radar observations of the landing areas of the Surveyor satellites might resolve some of the disagreement about the physical nature of the lunar surface. Radar mapping methods can be applied relatively inexpensively to the entire visible portion of the lunar surface, and the physical nature of unexplored areas can be determined through radar by simple extrapolation. Further, lunar radar mapping can be extended to planetary investigations. M.W.R.

N67-14281# Manchester Coll. of Science and Technology (England). Dept. of Physics.
LABORATORY SIMULATION OF LUNAR LUMINESCENCE Scientific Summary Report No. 2, Mar. 1965–Mar. 1966
J. E. Geake Apr. 1966 14 p refs
(Contract AF 61(052)-798)
(AFCRL-TR-66-665; AD-640495) CFSTI: HC $1.00/MF $0.50

The report concerns mainly further investigation of the proton-excited luminescence of meteoritic material. The source of the different types of luminescence from the enstatite achondrites was elucidated by neutron activation analysis, and the characteristic luminescence spectra of difference classes of meteorites were investigated. The effect of proton damage both on the efficiencies and on the spectra were investigated; it was also found that heating produces recovery from damage, and this process is being studied. TAB

N67-14282# European Space Technology Center, Noordwijk (Netherlands).
ATTITUDE PERTURBATIONS AND MAGNETIC CONTROL OF A SPIN STABILIZED SATELLITE, PART II
Marc L. Renard Paris, ESRO, Jul. 1966 212 p refs
(ESRO-TR-2) CFSTI: HC $6.00/MF $1.25

Continuing the theory contained in ESRO TR-1, analytical expressions are developed, which describe the attitude drift of a spin-stabilised satellite, which is controlled magnetically through a coil whose moment is parallel to the spin axis. Free and controlled drifts, following one of the typical control laws, are studied. The assumption of a polar dipole for representing the earth's magnetic field is relaxed to a nonpolar one, rotating with the earth. An assessment is included of the use which can be made of the latter, in order to generate the suitable correction, even in 'ambiguous' cases. Finally the results of a digital computer study are given, which show the characteristic features of each of the attitude disturbing and control torques. The simulation of control 'in a point' or 'in a plane' also confirms the critical evaluation based on the theory. Author (ESRO)

N67-14296# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
OPTIMAL TRANSFER BETWEEN HYPERBOLIC ASYMPTOTES (WHEN THE PLANET HAS A FINITE RADIUS) [TRANSFERTS OPTIMAUX ENTRE ORBITES HYPERBOLIQUES (RAYON PLANETAIRE NON NUL)]
Christian Marchal [1966] 12 p refs In FRENCH; ENGLISH summary Presented at the 12th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966 Submitted for Publication
(TP-291) CFSTI: HC $1.00/MF $0.50

If infinitesimal maneuvers at infinity are not taken into account, the optimal transfers between hyperbolic asymptotes only depend on the velocity vector of arrival, the velocity vector of departure and the escape velocity from the ground of the planet (the mass and the radius of the planet only matter in the scale of the transfer). Optimal transfers are planar and impulsional (but in some cases equivalent non-planar transfers are present); there are never more than two finite impulses. The use of optimal transfers between hyperbolic asymptotes during a travel to Mercury or the minor or major planets permit saving of a few km/s in the characteristic velocity. Author (ESRO)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N67-13572*# Volt Technical Corp., Washington, D. C.
PROTON-3 SPATIAL SUPER-LAB [PROTON 3 SUPER-LABO SPATIAL]
Germain Ajoux 12 Oct. 1966 5 p Transl. into ENGLISH from Pourquoi Pas (Brussels), 11 Aug. 1966 p 58-60
(Contract NAS5-12487)
(NASA-CR-80688; ST-PR-INS-CR-10524) CFSTI: HC $0.50 CSCL 22B

A journalistic account is given of the Proton-3, and the instrumentation is briefly described. The purpose of the satellite is identified as observing the high energy particles of the cosmic rays. The design of the ionization calorimeter to study the particles is reviewed. Telemetric and trajectory measuring apparatus, and sensors to determine the station's position are mentioned. N.E.N.

N67-13710# Minnesota Univ., Minneapolis. Cosmic Ray Group.
THE CONSTRUCTION, CALIBRATION AND OPERATION OF THE UNIVERSITY OF MINNESOTA EXPERIMENTS FOR OGO-I AND OGO-III
S. R. Kane, K. A. Pfitzer, and J. R. Winckler Sep. 1966 48 p refs
(CR-87)

Response characteristics of the ionization chamber and electron spectrometer experiments flown on the OGO-I and OGO-III satellites are considered. In the outer radiation belt, the ion chamber response is attributed entirely to energetic electrons that penetrate the chamber wall. Here, the ion chamber constitutes a stable, sensitive counter with a dynamic range for electrons above 600 kV energy. Calculation of absolute fluxes of particles from the counting rates of the OGO instruments is described, and instrumental constants for these flux determinations are summarized. Cross-calibration between the ion chamber and spectrometer and sampled data in the outer radiation belts is included. Responses to electrons, X-rays, protons and heavier nuclei, and cosmic rays in free space are detailed for the OGO-I ion chamber experiment; and attention is given to the normalization and calibration of the ion chamber, correction for dead-time of the reset switch, and the dynamic range and linearity of response. M.W.R.

N67-13874*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
A STUDY OF ELECTRONIC PACKAGES, ENVIRONMENTAL CONTROL SYSTEMS AND VEHICLE THERMAL SYSTEMS INTEGRATION Quarterly Report, Aug.-Oct. 1966
D. J. Watanabe 28 Oct. 1966 155 p refs
(Contract NAS8-20320)
(NASA-CR-80771; SID-66-1739; QR-2) CFSTI: HC $5.00/MF $1.00 CSCL 22B

This study is directed toward determining the optimum environmental control (passive or active) systems for thermally conditioning individual electronic packages for space missions of durations ranging from 4-1/2 hours to 180 days. The environmental control system shall be optimized on the bases of mission duration, operational temperature limits, and heat dissipation rate of the electronic package. This report describes additional data ot augment the basic requirements and constraints, the survey effort in determining the developmental trends, the parametric study of thermal control processes and components, and the synthesis and reliability analysis of integrated systems. Author

N67-14178*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A STUDY OF A GRAVITY-GRADIENT-STABILIZED NIMBUS SPACECRAFT Final Study Report, Jul.-Dec. 1965
21 Jan. 1966 180 p refs
(Contract NAS5-9611)
(NASA-CR-80800; Doc.-665D4202) CFSTI: HC $5.00/MF $1.00 CSCL 22B

Results are presented of a six-month, fixed-price study of a gravity-gradient stabilized NIMBUS spacecraft. The objective of this study was to provide a preliminary spacecraft design capable of meeting specified performance requirements for a nominal 750-nautical-mile, "high-noon", sunsynchronous orbit. Additionally, performance of the spacecraft was to be determined under conditions of uncompensated internal momentum, orbital-plane drift from nominal conditions, and a range in orbital eccentricities. The spacecraft features the NIMBUS sensory ring, with its present thermal control subsystem, three SNAP-19 radioisotope thermoelectric generators (RTGs), and a gravity-gradient torqued, passively-damped, three-axis control subsystem. The scope of the study reported in this documentation is limited to the selection and preliminary design of the spacecraft configuration and the selection and performance analysis of the passive attitude control subsystem. Author

N67-14186# ASAT Arbeitsgemeinschaft Satellitentraeger Systeme, Munich (West Germany).
ELDO FUTURE PROGRAM STUDY 3:5. VOLUME 2: PROJECT STUDY ABOUT A 5.5 t H_2/O_2 UPPER STAGE FOR THE ELDO B1 AND B2 VEHICLES
Apr. 1965 492 p Prepared for ELDO
CFSTI: HC $7.91/MF $2.25

An optimum upper stage for the ELDO B1 launch vehicle which is also suitable as third stage of the ELDO B2 launch vehicle is defined. Design fundamentals and development problems of high energy upper stages are discussed; details of structural design, propulsion system, attitude control system and equipment and operations, reliability and test requirements are presented. Development costs are indicated. ESRO

N67-14188# Institut d'Aeronomie Spatiale de Belgique, Brussels.
TABLE OF ARTIFICIAL SATELLITES, 1957-1965 [TABLEAU DES SATELLITES ARTIFICIELS, 1957-1965]
J. Vercheval 1965 38 p In FRENCH
(F-2-1965) CFSTI: HC $2.00/MF $0.50

General charactaristics of artificial satellites put into orbit from 1957 till mid-November 1965 are given in a list made up in alphabetical order. The first table gives names of satellites and their national origin and mentions nature and missions. The second one gives details as to launching and reentry dates (universal time), initial altitudes of perigee and apogee, total mass of the satellite and the frequencies used for the transmission of scientific data and tracking or telemetry signals (in megacycles per second). ESRO

N67-14203*# Stanford Univ., Calif. School of Engineering.
ICARUS: INTER-PLANETARY CRAFT FOR ADVANCED RESEARCH IN THE VICINITY OF THE SUN
Varada P. Charyulu, ed. Aug. 1966 224 p refs
(Contract NSR-05-020-151)
(NASA-CR-80840) CFSTI: HC $6.00/MF $1.25 CSCL 22B

A preliminary design study of ICARUS, an advanced solar probe, is presented. ICARUS will explore the region of space between 1 and 0.1 AU from the sun, both in and out of the ecliptic plane, and measure cosmic rays, solar particles, and magnetic fields. The major problem encountered in the spacecraft design was the 100-fold increase in solar radiation found at 0.1 AU. The spacecraft consists of a flat spin stabilized body of revolution with its axis normal to the orbit plane. This arrangement minimizes solar heat inflow and maximizes the heat rejected by radiation. The basic load carrying structure is beryllium and the fiberglass reinforced plastic outer shell is in the form of a frustrum of a cone. The solar cell power supply is on a flared conical skirt attached to the probe's bottom. It provides 40 watts near earth and 242 watts near the sun. Minimum heat inflow is achieved by optical solar reflectors and superinsulation. Travelling wave tubes provide communication data rates of more than 500 bits/sec. Data reduction and processing and analog to digital conversion is performed by a central data system in the spacecraft. R.N.A.

N67-14243*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SELECTED PAPERS ON ENVIRONMENTAL AND ATTITUDE CONTROL OF MANNED SPACECRAFT
Washington, NASA, Dec. 1966. 96 p refs
(NASA-TM-X-1325) CFSTI: HC $2.50/MF $0.75 CSCL 22B

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7. LUNAR STAY TIME EXTENSION MODULE C. I. Tynan, Jr. p 67–77 (See N67-14250 04-30)

8. WATER-IMMERSION TECHNIQUE FOR SIMULATION OF INGRESS–EGRESS MANEUVERS UNDER CONDITIONS OF WEIGHTLESSNESS O. F. Trout, Jr. p 79–87 (See N67-14251 04-05)

N67-14244*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMICS AND CONTROL RESEARCH APPLICABLE TO APOLLO EXTENSION SYSTEMS
Peter R. Kurzhals, Claude R. Keckler, and William M. Piland *In its* Selected Papers on Environ. and Attitude Control of Manned Spacecraft Dec. 1966 p 1–10 refs (See N67-14243 04-31)
CFSTI: HC $2.50/MF $0.75

Attitude control of onboard experiments by the Apollo spacecraft must compensate for aerodynamic and gravity-gradient torques, crew motion effects, and disturbances such as those caused by centrifuge operation. External and internal disturbances that can be anticipated on an earth-orbital mission are reported, and the fuel compensation required to compensate for disturbances and to provide control for these experiments is given. Since most of the control tasks and the applied disturbances are periodic, the Apollo reaction jet system becomes inefficient sooner than the control moment gyro systems. These disturbance and control aspects anticipated by Apollo extension system missions are discussed, and disturbance profiles and vehicle response for zero gravity operation are given for 45 and 90 day missions. Disturbance envelope and experiment requirements are used to develop an optimum control system; and some of the experiments are simulated to determine the effectiveness of the system, which is a control-moment gyro-jet combination. M.W.R.

N67-14266# Entwicklungsring Nord, Bremen (West Germany).
ELDO FUTURE PROGRAM STUDY 3.2 ON AN ELDO B LAUNCHING SYSTEM WITH A STANDARD ENGINE OF 6–8 TONS OF THRUST
31 Aug. 1964 62 p refs Prepared for ELDO
CFSTI: HC $2.00/MF $0.75

An investigation was conducted on the influence which the selections of a standard engine with 6 to 8 tons of thrust exerts on the performance of an ELDO B launch vehicle with two H_2/O_2 upper stages totalling 23 tons upper stage weight, including propellants and payload. Included are calculations for an ELDO B2-stage launch vehicle with a view to use of its upper stages in an ELDO C vehicle. ESRO

N67-14270# Societe pour l'Etude et la Realisation d'Engins Balistiques, Courbevoie (France).
ELDO FUTURE PROGRAMME STUDY NO. 3-5. SUMMARY OF PRELIMINARY STUDY OF ELDO LAUNCH VEHICLES B-1 AND B-2 [PROGRAMME FUTUR ELDO ETUDE NO. 3-5. RESUME DE L'ETUDE D'AVANT-PROJECT DES LANCEURS B-1 ET B-2]
Sep. 1965 64 p In FRENCH Work performed for ELDO
(DTA/3-12/5-616) CFSTI: HC $3.00/MF $0.75

This report defines two possible future ELDO launch vehicles, ELDO-B-1 (a two-stage vehicle) and ELDO-B-2 (a three-stage vehicle), where the first stage is the BLUE STREAK rocket and the upper stages liquid O_2/H_2 rocket motors. It includes details of configuration and payload of the upper stages and estimates performances of the launch vehicles. ESRO

N67-14273# European Space Vehicle Launcher Development Organization, Paris (France).
ACTIVE TELECOMMUNICATIONS SATELLITES [LES SATELLITES ACTIFS DE TELECOMMUNICATIONS]
M. Gilli [1966] 46 p refs In FRENCH
(ELDO-TM-F37) CFSTI: HC $2.00/MF $0.50

The principal characteristics of active telecommunications satellites launched or projected are listed. Author (ESRO)

N67-14292# Bolkow Entwicklungen K. G., Munich (West Germany).
ELDO FUTURE PROGRAM STUDY 3.7: PERFORMANCE ANALYSIS ELDO B1 LAUNCH VEHICLE
Aug. 1965 86 p Prepared for ELDO
(BOLKOW-RF-34) CFSTI: HC $3.00/MF $0.75

Studies optimum propellant mass for second stage of the ELDO B1 vehicle for launches from Woomera or an equatorial site. Four types of orbit are considered: 1) low circular orbits with direct injection, 2) high circular orbits with Hohmann transfer from a parking orbit, 3) elliptical orbits with fixed perigee (including high circular orbits reached by an apogee motor) and 4) escape missions. Trajectories are calculated for four or five representative orbital altitudes between 200 and 100,000 km. ESRO

N67-14293# Entwicklungsring Nord, Bremen (West Germany).
ELDO FUTURE PROGRAM STUDY 4.1. ELDO C SATELLITE LAUNCHER VEHICLES
15 Apr. 1964 162 p Prepared for ELDO
CFSTI: HC $5.00/MF $1.00

Outlines the possibility of injecting a payload of 6 to 10 tons into a 500 km orbit utilizing development of Blue Streak rocket engine. Defines six possible 3 stage configurations for an ELDO launch vehicle utilizing H_2O_2 propellants, five for two upper stages in conjunction with one or more Blue Streak rocket engines and one for all three stages. Development costs are considered. ESRO

N67-14294# Arbeitsgemeinschaft Satellitentraeger (ASAT), Munich (West Germany).
ELDO FUTURE PROGRAM STUDY 3.5, VOLUME 2. ELDO-B LAUNCHER
Apr. 1965 371 p Prepared for ELDO
(ASAT II, Vol. 2) CFSTI: HC $7.00/MF $1.75

Presents detailed design for three possible configurations of the ELDO B1 launch vehicle and six possible configurations of the ELDO B2 launch vehicle. Describes the design of the liquid H_2/O_2 upper stages, in particular a complete analysis of a 5.5 t upper stage. Includes performance data based on flight path calculations and indicates possible development program and costs. ESRO

N67-14295# Arbeitsgemeinschaft Satellitentraeger (ASAT), Munich (West Germany).
ELDO FUTURE PROGRAM STUDY 3.5, VOLUME 1. ELDO-B LAUNCHER
Apr. 1965 325 p Prepared for ELDO
(ASAT II, Vol. 1) CFSTI: HC $7.00/MF $0.50

Presents detailed design for three possible configurations of the ELDO B1 launch vehicle and six possible configurations of the ELDO B2 launch vehicle. Contains design data for the complete vehicle including aerodynamic loading and performance data based on flight path calculations. Possible development program and cost are indicated. ESRO

N67-14297# Arbeitsgemeinschaft Satellitentraeger (ASAT), Munich (West Germany).
ELDO FUTURE PROGRAM STUDY 3.6, VOLUME 1. DESCRIPTION, ANALYSIS AND PERFORMANCE OF THE LAUNCH VEHICLES ELDO B1 AND B2
Apr. 1965 214 p Work Performed for ELDO
(ASAT I, Vol. 1) CFSTI: HC $6.00/MF $1.25

Defines the ELDO B1 and B2 multistage launch vehicles and gives details of their design, flight criteria, performance, and guidance, navigation and tracking systems. Both vehicles have a Blue Streak rocket motor as first stage. B1 has one H_2/O_2 upper stage and B2 two H_2/O_2 upper stages. ESRO

N67-14302# European Space Research Organization, Paris (France). European Space Technology Center
THE LAUNCH VEHICLE
J. Vandenkerckhove Mar. 1966 40 p refs
(ESRO-TM-24) CFSTI: HC $2.00/MF $0.50

The launch vehicles available or under development (August 1964) are listed and criteria are given for selection of a launch vehicle for a particular mission. Scout, Thor-Delta, Thor-Agena and Atlas-Agena are described, with information on performance, availability, reliability, launch facilities, and costs. Diamant and Europa I are mentioned only briefly, since they will be dealt with in subsequent papers. Rough performance figures are given for the larger NASA vehicles: Atlas-Centaur, Titan, and Saturn. The paper ends with a brief discussion of the relative costs of the various launch vehicles, illustrated by a graph of the cost to launch unit payload plotted against the payload capability of the vehicle. Author (ESRO)

N67-14313# Library of Congress, Washington, D. C. Aerospace Technology Div.
SPACECRAFT UTILIZING THE LIFTING AND BALLISTIC REENTRY TECHNIQUES. PART II: REVIEW OF THEORETICAL STUDIES IN LIFTING AND BALLISTIC REENTRY
Victor Klein and Alexis Baratoff 31 Aug. 1966 119 p refs
(ATD-66-106)

A comprehensive review is presented of papers published in foreign scientific sources on theoretical and experimental studies relating to the problems of high speed lifting and ballistic flights, and atmospheric entry techniques. Also included is an annotated bibliography with references to articles on aeromechanics of high speed flows, including supersonic and hypersonic aerodynamics, aerothermodynamics of high speed flows, including aerothermophysics and aerothermal structural responses; flight mechanics, including aerodynamic performance and reentry dynamics; and strength of space vehicle components, including static stress and strain analyses, and dynamic stress and strains. R.N.A.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N67-13398# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE DERIVATION OF A REFINED THEORY OF PLATES
M. P. Sheremet'yev and B. L. Pelekh *In its* J. of Eng. 21 Jun. 1966 p 8-16 refs (See N67-13396 04-34) CFSTI: HC $1.00/MF $0.50

A general theory of plates is constructed which satisfied four out of six conditions on boundary planes $z = \pm h$. Such conditions can be either static or geometrical conditions, or conditions of a mixed type. The introduction of the energy component of deformation makes it possible to write the elasticity relationships in a general simple formulation. The general statement of the problem of the theory of plates in stress moments and functions of tensions avoids the difficulties encountered in other works. Solutions are given for some concrete problems. R.N.A.

N67-13610# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
DESIGN AND TEST OF RING-STIFFENED FIBER GLASS CYLINDERS UNDER EXTERNAL PRESSURE
R. J. Miller, R. J. Nebesar, and M. H. Schneider, Jr. [1966] 37 p refs Presented at the Soc. of the Plastics Ind., Chicago, 10 Feb. 1966
(Douglas Paper-3535)

Methods of design and analysis are presented for ring-stiffened cylinders constructed from filament-reinforced composites. Possible modes of failure, such as compressive and interlaminar shear stresses in each layer, overall buckling, and local buckling of the rings and shell between rings, are analyzed. The equations are programmed for the IBM 7094 computer to aid in design. The analytical results are applied to the design of 6-in.-diameter, ring-stiffened fiber glass cylinders. Development of processing methods and fabrication techniques used in the construction of the cylinders are discussed, as well as the test procedure and test results. One of the test cylinders constructed with S glass and epoxy matrix achieved a failure pressure of 14,011 psi, with a weight-displacement ratio of 0.49. The major conclusion is that achieving high structural efficiencies for highly loaded filament-reinforced structures depends on accurate methods of analysis, careful detail design, and high quality hardware. Author

N67-13707# Lockheed Missiles and Space Co., Palo Alto, Calif.
SOME QUESTIONS OF THE THEORY OF PLASTIC DEFORMATION OF A METAL UNDER CYCLIC THERMAL LOADING
M. S. Mozharovskii [1966] 3 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 8, 1966 p 1011-1014

Because strain diagrams for metals under cyclic thermal loading indicate fundamental parameter changes due to the large number of heat changes, a theoretical study of plastic deformation is made. Equations are written for compressive stress and strain and the stress-strain dependence without holding at high temperatures; as well as the change in compressive strain for holding a metal at high temperature. The total strain per cycle is evaluated, and after the *n*th cycle the plastic tensile and compressive deformations are found. The formula is given for finding the difference between the plastic tensile and compressive deformations after the *n*th cycle; and, finally, the equation is evolved for calculating the plastic tensile strain in any cycle. M.W.R.

N67-13709# Lockheed Missiles and Space Co., Palo Alto, Calif.
NATURAL VIBRATIONS OF CYLINDRICAL SHELLS IN A HYPERSONIC FLUID FLOW
V. S. Gontkevich and V. V. Ponomarenko [1966] 7 p refs Transl. into ENGLISH from the book "Dinamika i Prochnost' Mashin, No. 3" Kharkov, Kharkov Univ. Press, 1966 p 98–105

Axisymmetric vibrations of circular cylindrical shells in a hypersonic flow are considered; and vibration equations are found by using the Kirchhoff–Love thin shell theory and the so-called piston theory. By using the boundary conditions, the frequency parameters are found and the vibrations mode are constructed. Formula for the damping coefficient of the natural vibrations of a shell in a gas flow is given, and evolution of the first two shell vibrations mode with increase in flow velocity is tabulated for fixed, supported, and cantilever shells. A representation is given for the modes of the natural non-axisymmetric vibrations of circular shells in hypersonic gas flow. M.W.R.

N67-13720*# National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.
STRUCTURAL OPTIMIZATION WITH PROBABILITY OF FAILURE CONSTRAINT
Dhanjoo N. Ghista Washington, NASA, Dec. 1966 17 p refs
(NASA-TN-D-3777) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The concept of probability of failure is explained for a general structural system under simultaneous and alternative load systems. It is then shown how the probability of failure constraint can be formulated in terms of the structural design parameters. This constraint is developed in detail for optimizing a simple truss whose design parameters are the section areas of the members. The optimizing weight function and the constraint in terms of the design parameters define the mathematical model of the structural optimization problem. The structural synthesis method is suggested for solving the mathematical programming problem, and it is shown how the probability of failure constraint can be incorporated in the synthesis technique. The application of the constraint is illustrated by means of two simple examples with reference to the truss. Author

N67-13725*# Minnesota Univ., Minneapolis.
INTERNAL FRACTURE CAUSED BY FOCUSING OF EXPLOSIVE WAVES
C. C. Hsiao, S. R. Moghe, C. K. Soong, and W. L. Yin Sep. 1965 10 p refs
(Grant NGR-24-005-070; Contract AT(11-1)-532)
(NASA-CR-80740; TR-101) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Experimental success in reflecting and focusing explosive waves and thus fracturing the neighborhood of a focus in a prolate spheroid is obtained. The shape and size of the internal fracture is essentially spherical whose volume ranges from a pinpoint to several millimeters in diameter. On the basis of a simple consideration of the transmission of elastic strain energy, corresponding sizes of fracture can be analyzed and estimated. Comparison of the theoretical results with experimental data indicates that the strain energy transmitted is directly proportional to the amount of explosive charge used. Author

N67-13784*# National Aeronautics and Space Administration, Washington, D. C.
THE SUBJECT OF CONSTRAINT EQUATIONS RELATING STRESSES AND STRAINS IN FIBER GLASS [OB URAVNENIYAKH SVYAZI MEZHDU NAPRYAZHENIYAMI I DEFORMATSIYAMI V STEKLOPLASTIKAKH]
G. A. Wang Fou Feng Oct. 1966 10 p refs Transl. into ENGLISH from Prikl. Mekhan. (Kiev), v. 1, no. 2, 1965 p 110–115
(NASA-TT-F-10379) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Based on models of a nonhomogeneous body, constraint equations are derived for a singly-reinforced strip with proper consideration for the rheological properties of the binder. It was established that, to describe the creep properties of a unidirectionally reinforced strip, it is necessary to take into consideration the time variation in the Poisson ratio and the modulus of elasticity of the binder. A comparison was made between the derived theoretical formulas and the results of experimental investigations of fiber glass in the elastic deformation range of the binder. Author

N67-13802# Lockheed Missiles and Space Co., Palo Alto, Calif.
NATURAL BENDING-TWISTING VIBRATIONS OF A VARIABLE-MASS BEAM WITH CONCENTRATED LOADS, III
K. Ia. Kukhta [1966] 2 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 8, 1966 p 1004–1005

A calculation method is given that determines the natural frequencies and modes of bending and twisting vibrations in a variable mass beam under concentrated loads which has a free and a fixed end. A combination selection–chord method is used to find the required number of frequencies in increasing order until the final vibration mode is obtained. G.G.

N67-13803# Lockheed Missiles and Space Co., Palo Alto, Calif.
AXISYMMETRIC DEFORMATION OF A TOROIDAL SHELL WITH VARIABLE WALL THICKNESS
V. A. Sukharev [1966] 4 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zaved., Mashinostr. (Moscow), no. 6, 1966 p 16–20

An analytical method for integrating the governing differential equation of a symmetrically loaded toroidal shell is considered. The geometry of the shell is characterized by the shell thickness quantities and included into the governing differential equation for a symmetrically loaded variable thickness shell of revolution. Determination of the stress moments and displacements in the shell is carried out by separating real and imaginary parts in the complex shell resolving function and substituting them in the computational formulas. G.G.

N67-13855 General Motors Corp., Santa Barbara, Calif. Flight Physics Lab.
IMPACT PHYSICS, METEOROIDS, AND SPACECRAFT STRUCTURES
A. C. Charters, J. W. Gehring, and C. J. Maiden *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 247–297 refs (See N67-13842 04-12)

The fields of astronomy and high velocity impact are surveyed for knowledge pertinent to the problem of the meteoroid hazard to spacecraft, and recent results of high velocity impact research are presented. The field of high velocity impact is reviewed from the standpoint of impact physics. The discussion of mechanical energetics centers on shock processes in solids, strength properties at high rates of stress and strain, fracture and spalling, and momentum transfer. Consideration of thermal energetics includes shock wave heating, reversible-irreversible thermal cycles, equations of state, and impact flash. Recent results of impact in composite targets are discussed showing the effects of thin shields on projectile fracture and melting, of shield properties on composite structure effectiveness, of spalling and delamination of hull walls, etc. Also, results are presented from tests of armored radiator tubes for spacecraft nuclear power plants. In addition, measurements of momentum transfer and impact flash are described. Author

N67-13856 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EVALUATION OF THE IMPACT PERFORMANCE OF REALISTIC SPACE STRUCTURES
James L. Summers *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1 1966 p 299–314 refs (See N67-13842 04-12)

Small spheres of aluminum and glass were fired at velocities from 4000 to 23,000 feet per second into a variety of composite structures representative of various types of space vehicle construction. These structures were single-walled samples, multiple-walled samples having a variety of fillers of different composition and density including structural elements of aluminum honeycomb, and non-metallic materials representative of ablative heat-shield components. The results of the tests indicated that, first, the impact performance criterion selected strongly influences the choice of the final structural configuration and, second, because of the complex nature of the failure of composite structures, realistic test specimens must be employed. Author

N67-13857 Institut Franco-Allemand de Recherches, St. Louis (France).

STUDY OF HIGH VELOCITY IMPACTS WITH THE USE OF A HEAVY GAS CANON [ETUDE D'IMPACTS A GRANDE VITESSE A L'AIDE D'UN CANON A GAZ LEGER]

C. L. Lecomte and R. Schall *In* AGARD- The Fluid Dyn. Aspects of Space Flight, Vol. 1, 1966 p 315-330 refs In FRENCH (See N67-13842 04-12)

The impact of cylindrical or spherical projectiles, at speeds of approximately 9 km/s, produced hemispheric craters in semi-infinite targets, the volume being proportionate to the kinetic energy. Polyethylene cylinders, however, gave truncated craters in dural. The energy necessary to deepen the crater is, in this case, greater than for projectiles in dural. In the first approximation, this energy is proportional to a Brinell hardness, even for hot worked aluminum targets. The velocities and directions of secondary projectiles emitted during impact are determined. Transl. by R.U.

N67-13858 Royal Armament Research and Development Establishment, Fort Halstead (England).

EXPERIMENTAL STUDIES OF HYPERVELOCITY IMPACT WITH THE R.A.R.D.E. 1/4 INCH CALIBRE LAUNCHER

A. J. Cable *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1, 1966 p 331-341 refs (See N67-13842 04-12)

Studies have been made of the hypervelocity impact at speeds from 20,000 ft/sec to 30,200 ft/sec of polythene projectiles on semi-infinite aluminum targets at angles of obliquity between 20° and 90° to the surface of the targets. The tests were made using the hypervelocity launcher, which is a two-stage light-gas gun firing projectiles of 1/4 inch calibre. These tests showed that the crater produced by the impact is hemispherical in shape; its volume is proportional to the kinetic energy the projectile would have if moving with the component of its velocity normal to the surface of the target, except for the most oblique impact, where this relation is slightly in error. The phenomenon of an unusual pattern on the surface of the crater which occurred in these tests was found to be caused by marks on the front surface of the projectile. This gives the possibility of measuring the surface distortion of the crater which occurs during impact. Author

N67-13859 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

SUMMARY REPORT ON THE THEORY OF HYPERVELOCITY IMPACT

J. M. Walsh, W. E. Johnson, J. K. Dienes, J. H. Tillotson, and D. R. Yates *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1, 1966 p 343-387 refs (See N67-13842 04-12)
(Contract DA-04-495-AMC-116(X); ARPA Order 71-62)

This study is devoted primarily to solid-solid impact at velocities in the meteoric range. A continuous Eulerian hydrodynamic code is used to integrate numerically the flow equations for several series of impact problems. The impact velocity, the projectile shape, the density of the projectile, and the equation of state of the interacting materials are varied. Impact crater dimensions are found to increase as the 0.58 power of the impact velocity. Projectiles of the same mass but different densities have the same overall impact effects on the target, for velocities about 10^6 cm/sec. One-dimensional and axisymmetric impacts are also computed for materials with an ideal-gas equation of state. These calculations provide some important comparisons with analytical work on the problem of hypervelocity impact. Many of the concepts used in solid-solid impact are already present in the one-dimensional problem. The theory for this well-understood impact is discussed in considerable detail. Author

N67-13860 National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

MOMENTUM TRANSFER AND CRATERING PHENOMENA ASSOCIATED WITH THE IMPACT OF ALUMINUM SPHERES INTO THICK ALUMINUM TARGETS AT VELOCITIES TO 24,000 FEET PER SECOND

B. Pat Denardo and C. Robert Nysmith *In* AGARD The Fluid Dyn. Aspects of Space Flight, Vol. 1, 1966 p 389-402 refs (See N67-13842 04-12)

Spheres of 2017-T4 aluminum with diameters of 1/16, 1/8, 1/4, and 1/2 inch were launched into semi-infinite targets of 2024-T4 and 1100-0 aluminum. The momentum transfer during impact was measured by means of a simple ballistic pendulum to which the target was attached. The ratio of target momentum to projectile momentum increased with increasing projectile velocity and with projectile diameter. Mass loss due to cratering, penetration, and crater diameter were also obtained for these experiments. It was noted that the variation of these parameters was also a function of the projectile diameter. No conclusive evidence was uncovered to explain this apparent scale effect. However, close examination of the various craters suggests that the cratering process is, in fact, different for the different size projectiles. The cause for this difference has yet to be resolved. Author

N67-13861# Lockheed Missiles and Space Co., Palo Alto, Calif.

ON NONISOTHERMAL DEFORMATION OF A VISCOELASTIC MEDIUM

A. I. Chudnovskii [1966] 7 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), no. 3, 1966 p 84-89

The question of nonisothermal deformation of a viscoelastic medium is considered on the basis of the thermodynamics of irreversible processes. This approach, under well founded assumptions on the construction of the fundamental thermodynamic potential, leads to the conclusion that the state of a viscoelastic medium depends not only on the moving value of the temperature field, but also on the history of its change. The obtained relationships permit a foundation for the theoretical physics principle and extends it to the case of nonisothermal processes. C.T.C

N67-13869# Martin Co., Baltimore, Md.

IMPACT ENERGY ABSORPTION PROPERTIES OF CRUSHABLE MATERIALS

Andrew F. Conn Oct. 1966 55 p
(RM-315)

The desire to land instruments, and eventually men, on other bodies in our solar system has motivated considerable research for ways to make this landing reasonably gentle, while satisfying strict weight and size limitations, and providing maximum reliability. Investigations of various concepts have indicated that such requirements are best met by landing systems which use material deformation. This report summarizes the results of an experimental investigation of the dynamic mechanical properties of a variety of energy absorbing materials. It is shown that by combining metallic or plastic honeycombs with a rigid foam cellfiller, a broad range of energy absorption properties can be obtained. It now appears

that by the selection of the most suitable foam-filled honeycomb, the designer may be able to satisfy the requirements of each unique landing mission. Author

N67-13908# Aeronutronic, Newport Beach, Calif.
EFFECT OF CONSTITUENT MATERIAL PROPERTIES ON THE STRENGTH OF FIBER-REINFORCED COMPOSITE MATERIALS Annual Report, Jan. 1965–Jan. 1966
Stephen W. Tsai, Donald F. Adams, and Douglas R. Doner Aug. 1966 180 p refs
(Contract AF 33(615)-2180)
(U-3592; AFML-TR-66-190; AD-638922) CFSTI: HC $5.00/MF $1.00

The investigation is concerned with the theoretical prediction of the contribution of the constituent material properties to the macroscopic principal moduli and strengths of a unidirectional fiber reinforced composite. The theoretical results obtained for the prediction of the stiffness and strength have been compared with experimental data obtained using boron-epoxy and glass-epoxy composites. TAB

N67-13910# Westinghouse Electric Corp., Pittsburgh, Pa.
DETERMINATION OF STRESSES AT NON-RADIAL OPENINGS IN SPHERICAL PRESSURE VESSELS
M. M. Leven Mar. 1966 35 p refs
(Contract NObs-90132)
(Rept.-66-9D7-520-R1; AD-638994) CFSTI: HC $2.00/MF $0.50

An attempt was made to simulate experimentally the theoretical case of an oblique hole in a pressurized spherical vessel. For the case of an opening of diameter ratio 0.129 and at 45 degrees to the radial direction, seven different closure schemes were tried. These are listed as WS-16B1, WS-16B1 A to F, inclusive. Radically different stresses were obtained for each closure scheme, indicating a very sensitive dependence of stress on closure conditions. For 0 degree section (i.e., the section in which the acute angle between the opening and the vessel is at the inner surface) the maximum stress varied from 2.55S to 4.81S, S being the nominal stress in the spherical vessel. For the 180 degree section, the maximum stress variation was from 3.06 to 6.75S. Author (TAB)

N67-14108# Whittaker Corp., San Diego, Calif.
TRENDS AND APPLICATIONS OF STRUCTURAL COMPOSITE MATERIALS
David L. Grimes Paris, AGARD, Nov. 1965 18 p refs Presented at 21st Meeting of Struct. and Mater. Panel of AGARD, Nancy, 17 Nov. 1965
(AGARD-523) CFSTI: HC $1.00/MF $0.50

The history and present position of composite materials, are reviewed in particular, current uses of reinforced plastics in aircraft and missiles, construction and boats. New composite materials of high-strength high-modulus reinforcements are then considered; research and development in hand and future applications of these materials are discussed. Author

N67-14125# Northampton Coll. of Advanced Technology, London
A COMPARATIVE STUDY OF EXTRAPOLATION METHODS FOR CREEP DATA AT SMALL STRAINS
J. C. Levy and I. I. Barody London, Min. of Aviation, Jun. 1966 71 p refs
(Contract PD/90/01)
(S&T-MEMO-6166) CFSTI: HC $3.00/MF $0.75

Methods of extrapolating creep and rupture data, including the direct use of stress-time charts, the Rabotnov method, the Graham–Walles method, and the time–temperature parameters known as Dorn, Larson–Miller and Manson–Haferd, are reviewed with special reference to small creep strains. Creep data for aluminium alloy DTD 5070A are presented between temperatures of 100 deg C and 255 deg C, stresses between 5 and 21 ton/in^2 and times of up to 5,000 hours; the main interest centered on strains of up to 0.2%. Based on these results there was little to choose between the various parametric methods for interpolation and for limited extrapolation. For longer extrapolation, up to 30,000 hours, the Graham–Walles method provided a convincing guide to the expected upper limit of tolerance. Author

N67-14145# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DETERMINATION OF DISPLACEMENTS IN NONLINEARLY ELASTIC PLATES AND SHELLS
L. G. Odnoral [1961] 4 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 8, 1966 1007–1010

A method is presented of determining the displacement in nonlinearly elastic plates and shells by utilizing a theorem on reciprocity of work extended to problems of the mechanics of solids with physical and geometric nonlinearity. Author

N67-14218*# Measurement Analysis Corp., Los Angeles, Calif.
BASIC ANALOG CIRCUITS FOR TWO-DIMENSIONAL DISTRIBUTED ELASTIC STRUCTURES
R. L. Barnoski Washington, NASA, Jan. 1967 48 p
(Contract NAS8-20020)
(NASA-CR-667) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Linear elasticity theory and strain energy procedures are used as a basis for deriving analog circuits to describe the static elastic behavior of difference segments of a flat rectangular plate, a flat circular plate, and a cylindrical shell. These circuits are mathematically equivalent to finite-difference models, and physically equivalent to lumped parameter models. The dynamic circuit, called a mobility analog, is obtained from the static circuits by (1) redefining the voltages as spatial velocities; (2) substituting inductors for resistors; and (3) adding capacitors at appropriate nodes. The inductors account for the strain energy while the capacitors account for inertial forces associated with lumped masses. The transformer interconnections remain unchanged. It is pointed out that by knowing the analog circuit for the static elastic behavior of a specific distributed structure, the dynamic circuit is ensured. M.G.J.

N67-14238*# Israel Program for Scientific Translations, Ltd., Jerusalem.
BEAMS, PLATES AND SHELLS ON ELASTIC FOUNDATIONS
V. Z. Vlasov and U. N. Leont'ev 1966 366 p refs Transl. into ENGLISH of the book "Balki, Plity i Obolochki na Uprugom Osnovanii" Moscow, Gos. Izd. Fiz.-Mat. Lit., 1960 Published for NASA and NSF
(NASA-TT-F-357; TT-65-50135) CFSTI: HC $7.00/MF $1.75 CSCL 20K

Existing methods of analyzing beams and plates on elastic foundations are reviewed, and their shortcomings are pointed out. A variational method is proposed that will aid the engineer in selecting a scheme of calculations, establish the corresponding model of the elastic foundation, and solve the problem by relatively simple mathematical means. The proposed theory, based on Vlasov's general variational method, considers the elastic foundation as a single- or double-layer model whose properties are described by two or more generalized elastic characteristics. It is pointed out that one of the merits of the theory is that the solution to many problems is reduced to solving ordinary differential equations whose integrals can be found in tables. Consideration is given to problems of beams, plates, and spherical shells on elastic foundations, and to the dynamics and stability of these structures. An approach to contact problems, based on the method of initial functions, is also described, and examples are given. L.E.W.

N67-14263# Royal Aircraft Establishment, Farnborough (England).
A BEND METHOD FOR MEASURING FATIGUE CRACK PROPAGATION IN THICK MATERIALS
S. Pearson Jun. 1966 15 p refs
(RAE-TR-66204) CFSTI: HC $1.00/MF $0.50

A fatigue machine is described for making crack propagation experiments in bending, on specimens up to half inch thick. The test specimen is small and of simple shape to minimise machining time and cost. The machine can be readily adapted to make tests at high temperatures and to run at different frequencies. For two aluminium alloys comparison experiments on specimens cut from the same sheet of material gave good agreement for tests made in tension or in bending. Author (ESRO)

N67-14277# Royal Aircraft Establishment, Farnborough (England).
AN IMPROVED METHOD FOR PREDICTING MECHANICAL PROPERTIES OF FIBRE COMPOSITE MATERIALS
P. H. H. Bishop Aug. 1966 35 p refs
(RAE-TR-66245) CFSTI: HC $2.00/MF $0.50

A mathematical model is presented which enables the mechanical properties of fiber resin composites to be calculated with improved accuracy. This model is based on the standard netting analysis, but the indirect contributions of the fiber have been allowed for mathematically by introducing two hypothetical lateral fibers. The model has been used to analyse stiffness and strength data for glass-fiber epoxide-resin laminates, and to predict the behavior of a glass-fiber pressure vessel under simultaneous bending and internal pressure. Data predicted by the model did not differ from observed data by more than 17 per cent. The behavior of the pressure vessel was predicted satisfactorily. Author (ESRO)

N67-14299# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONLINEAR ACOUSTIC OSCILLATIONS OF A CYLINDRICAL SHELL
A. S. Vol'mir and I. G. Kil'dibekov 25 Apr. 1966 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), v. 17, no. 3, 1964 p 65–70
(FTD-TT-65-1948; TT-66-62423; AD-640259) CFSTI: HC $1.00/MF $0.50

The natural and acoustically forced nonlinear oscillations of cylindrical panels, having an ideal form, and also with consideration of initial inaccuracies in form of the center surface are investigated. Author (TAB)

N67-14315# Lockheed Missile and Space Co., Sunnyvale, Calif.
STRENGTH CRITERIA FOR ANISOTROPIC MATERIALS
I. I. Gol'denblat and V. A. Kopnov [1965] 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekh. (Moscow) no. 6, 1965 p 77–83

A generalized criterion for the strength of anisotropic materials, which possess different tensile and compressive strengths in each direction, as well as different resistivities to shear depending on the sign of the tangential stresses in each given plane, is proposed. The strength criterion is proposed for brittle materials (of fiberglass type), however, it may be used also as a plasticity condition for anisotropic materials if the appropriate yield points replace the strengths therein. The strength criterion under consideration has been verified experimentally. Author

N67-14330# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF AXIAL FORCES AND NORMAL PRESSURE ON FREE OSCILLATIONS OF CYLINDRICAL SHELLS
I. S. Rakhimov 18 Apr. 1966 13 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 8, 1964 p 42–48
(FTD-TT-65-1035; TT-66-62459; AD-640475) CFSTI: HC $1.00/MF $0.50

A discussion is given of the effect of axial forces and normal pressure on natural oscillations of circular orthotropic cylindrical shells. In maximum transition to isotropic shells the results are in excellent conformity with the existing solutions and experimental data. The approach to determine natural frequencies of oscillations of loaded shells which may be used in various industrial branches and in structural practice was investigated. Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N67-13357# California Univ., Berkeley. Lawrence Radiation Lab.
CONVECTIVE TRANSFER PROCESSES IN LAMINAR GAS-LIQUID CHANNEL FLOW
Charles Harry Byers and C. Judson King 20 May 1966 267 p refs
(Contract W-7405-ENG-48)
(UCRL-16535) CFSTI: HC $6.00/MF $1.25

Interphase mass transfer was studied experimentally and theoretically for cases where resistance to mass transfer is confined to the gas phase and where control is distributed between phases. A horizontal, rectangular channel of high aspect ratio was built. The gas and liquid phases, which move in stratified laminar flow, are contacted in an 18 in. long test section. The exit streams are analyzed in a gas-liquid chromatograph. A numerical solution was performed of the laminar transport equation for a parabolic velocity profile with a cocurrently moving boundary. Experiments in which pure ethanol was evaporated into two gases, CO_2 and oxygen, showed agreement with this theory within the estimated experimental error of 10%. It may be concluded from this study that cocurrent motion of the interface increases mass transfer. Experiments were carried out with the same fluids in countercurrent flow. Mass transfer is hindered by a flow reversal in the gas phase. A phenomenological model developed for this case correlated the data to within the experimental error of the method. Numerical solutions were performed of two cases of interphase mass transfer. The first is for parabolic velocity profiles in both phases, and the second assumes a parabolic profile in the gas and a constant velocity in the liquid. Experiments were carried out in which ether was evaporated from dilute ethanol solutions into two gases, CO_2 and helium, in cocurrent flow. The experimental results agreed with the first interphase mass transfer solution to within 15% in all cases. Equations for a more simplified model in which the liquid has a constant velocity and the gas velocity varies linearly with distance from the interface were solved analytically. Results of the appropriate interphase experiments agree with this theory. Interphase countercurrent experimental results agree substantially with a model that postulates penetration for the liquid phase and with the aforementioned countercurrent model for the gas phase. A series of cocurrent interphase experiments was made, using water as the solvent. Experimental results were lower than the predicted values by at least a factor of two. The apparent causes of the difficulty was accumulation of surfactants at the interface. Experimental mass-transfer coefficients indicate that the interfacial velocity was about 10 to 20% of the predicted velocity. This was confirmed by visual observation. Author (NSA)

N67-13460*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT-TRANSFER MEASUREMENTS ON A FLAT PLATE WITH ATTACHED PROTUBERANCES IN A TURBULENT BOUNDARY LAYER AT MACH NUMBERS OF 2.49, 3.51, AND 4.44
Lana Murphy Couch, Robert L. Stallings, Jr., and Ida K. Collins Washington, NASA, Dec. 1966 108 p refs
(NASA-TN-D-3736) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Heat transfer measurements were obtained on a flat plate and 17° ramp (both with and without longitudinal stringers) and attached protuberance models. The tests were conducted at the specified free-stream Mach numbers at a Reynolds number per foot of 3.0×10^6 in a 6.0-inch-thick boundary layer. The magnitude of heat transfer measurements obtained on the stringer plate was less than that obtained on the clean plate. High heating rates were obtained in a large area upstream of the bluff protuberance; however, for the more streamlined configurations the heating rates in the nose regions were relatively much lower. Maximum heating rates obtained on the stringer plate in the model wakes were approximately 139 percent greater than the values for the clean stringer plate. Wake heating rates were correlated for the general protuberances by plotting the heat transfer coefficients as a function of the plate surface length from the model centerbody–afterbody juncture. The heating rates obtained on the 17° ramp in the wakes of all models, except one, were approximately the same as those obtained on the 17° ramp for the clean stringer plate. Author

N67-13534 General Electric Co., Schenectady, N. Y. Research and Development Center.
AN ANALYSIS OF THERMALLY INDUCED FLOW OSCILLATIONS IN THE NEAR-CRITICAL AND SUPER-CRITICAL THERMODYNAMIC REGION Final Report
Novak Zuber Huntsville, Ala., NASA Marshall Space Flight Center, 25 May 1966 286 p refs
(Contract NAS8-11422)
(NASA-CR-80609) CFSTI: HC $6.00/MF $1.50 CSCL 20M

Three mechanisms which can induce thermo-hydraulic oscillations at near-critical and at super-critical pressures are distinguished and discussed. A quantitative formulation and analysis is presented for predicting the onset of these "chugging" oscillations as a function of fluid properties, system geometry and operating conditions. The problem is analyzed by perturbing the inlet flow, linearizing the set of governing equations and integrating them along the heated duct to obtain the characteristic equation. Conditions leading to aperiodic as well as to periodic flow phenonema are investigated. Stability maps and stability criteria are presented which, previously, were not available in the literature. The effects of various parameters are analyzed and improvements are suggested whereby the onset of flow oscillation can be eliminated. The similarity between "chugging" combustion instabilities and thermally induced flow oscillations at near and super-critical pressures is pointed out. A review of the present understanding of the near-critical thermodynamic region is also presented. Author

N67-13558# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
FORTRAN PROGRAMMES FOR THE PROCESSING OF BOMB CALORIMETRY DATA
P. Hawtin, S. A. Gardner, and R. A. Huber Aug. 1966 24 p refs
(AERE-R-5249) HMSO: 3s 6d

A series of FORTRAN (S2) computer programs for the evaluation of results obtained from an aneroid bomb calorimeter are described. BEDTIME evaluates the delay time from the temperature-time data and hence allows the calculation of the corrected temperature rise from the observed value. ICEBERG calculates the standard energy equivalent of the bomb from a benzoic acid calibration. ADHOC 2 calculates the change in internal energy content of carbon on combustion and the corresponding heat of combustion. Programs ICEBERG and ADHOC 2 require a knowledge of the delay time, found via BEDTIME or otherwise; and they are not therefore specific to data obtained from an aneroid bomb calorimeter. Additionally a subroutine COWBUC, used to calculate the Washburn correction according to the method of Porsen, is described. Author

N67-13703# Lockheed Missiles and Space Co., Palo Alto, Calif.
NONEQUILIBRIUM DISSOCIATION OF HEAT PROTECTIVE MATERIALS IN A HOT GAS STREAM
Iu. A. Dushin [1966] 5 p refs Transl. into ENGLISH from Neorgan. Mater. (USSR), v. 2, no. 7, 1966 p 1311–1314

Dissociation rate and temperature have been determined as a function of the heating condition for an arbitrary reaction regime in the case of heat protective machinery materials with high working gas temperature. Kinetic and diffusion solutions are given. To solve the problem of nonequilibrium dissociation in general form, the mass dissociation is considered as a result of direct and reverse reactions; the pressure of the dissociation products is determined; and, to obtain general purpose results, the difference in heat content that enters the transport parameter is estimated in terms of the characteristic Einstein temperature. A nomogram is plotted that not only determines the temperature of the working surface but also the dissociation rate; and results obtained for ammonium chloride indicate the need for a general investigation. M.W.R.

N67-13770# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
CRITICAL REVIEW OF EXPERIMENTAL HEAT TRANSFER COEFFICIENTS AND TEMPERATURE DISTRIBUTIONS IN TURBULENT BOUNDARY LAYERS AT SUPERSONIC AND HYPERSONIC FLOW [KRITISCHE DURCHSICHT EXPERIMENTELLER WARMEUBERGANGSZAHLEN UND TEMPERATURVERTEILUNGEN IN TURBULENTEN GRENZSCHICHTEN BEI UBER-UND HYPERSCHALLSTROMUNG]
J. C. Rotta Jul. 1966 46 p refs In GERMAN; ENGLISH summary presented at the AGARD Meeting "Recent Develop. in Boundary Layer Res.", Naples, 10–14 May 1965
(DLR-FB-66-51; AVA-FB-6609) CFSTI: HC $2.00/MF $0.50

Simple formulas to predict the heat transfer coefficients and temperature distributions of turbulent boundary layers are reviewed. On the basis of these theories, available experimental data are compared and turbulent Prandtl numbers are calculated from the experimental survey data. It is shown that boundary layers on wind tunnel nozzle walls differ greatly in their behavior from flat plate boundary layers. However, the experimental data are not free of discrepancies. No evidence can be furnished that the Crocco relation provides a satisfactory approximation to the temperature distribution in supersonic turbulent boundary layers with heat transfer. Author

N67-13789*# National Aeronautics and Space Administration, Washington, D. C.
EXTRAPOLATION OF EXPERIMENTAL THERMAL DATA TO HIGH PRESSURES [OB EKSTRAPOLYATSII EKSPERIMENTAL'NYKH TERMICHESKIKH DANNYKH V OBLAST' VYSOKIKH DAVLENIY]
I. Kh. Kipnis Nov. 1966 10 p refs Transl. into ENGLISH from Izh.-Fiz. Zh. (USSR), v. 10, no. 3, 1966 p 374–381
(NASA-TT-F-10386) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A method is proposed for extrapolating data on the isothermal line, using known thermodynamic equations, and errors in determining constants are reduced. Tait's and Byron's state equations are examined, and it is shown that Tait's equation and the modified Byron's equation may be used for extrapolation of thermal data for liquids and gases to the range of several thousands of atmospheres

within the temperature range to 1.5 T/T_k. Extrapolated and measured values of specific volumes are compared for methyl and ethyl alcohol, acetone, ether, water, hexane, heptane, propylene, ethylene, and nitrogen. N.E.N.

N67-13794*# National Aeronautics and Space Administration, Washington, D.C.
METHOD OF QUANTITATIVE EMISSION SPECTRAL ANALYSIS BASED ON THE MAXIMAL INTENSITY OF SPECTRAL LINES IN THE PROCESS OF BURNING A SUBSTANCE [METOD KOLICHESTVENNOGO EMISSIONOGO SPEKTRAL'NOGO ANALIZA PO MAKSIMAL'NOY INTENSIVNOSTI SPEKTRAL'NYKH LINIY V PROTSESSE VYGORANIYA VESHCHESTVA]
A. G. Nepokoychitskiy and A. A. Yankovskiy Nov. 1966 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 8, no. 6, Jun. 1964 p 372–375
(NASA-TT-F-10396) CFSTI: HC $1.00/MF $0.50 CSCL 20M

An empirical formula is derived for describing the change in the spectral line intensity during combustion of a measured quantity of substance under the effect of an electric discharge, based on the correlation between intensity at the instant of intensity increase, rate of burning, rate of increase in intensity under the experimental conditions used, and time. The formula is applied to quantitative emission analysis of a measured substance and to analysis of monolithic specimens of copper–zinc alloys of differing zinc contents. The method, based on the maximum line intensity during combustion of the substance, permits an increase in sensitivity and a reduction in time of spectral analysis over conventional methods using the integral line intensity without time resolution of the spectra. Author

N67-13799*# National Aeronautics and Space Administration, Washington, D.C.
A NEW METHOD OF SOLVING HEAT-CONDUCTION PROBLEMS FOR BODIES OF REVOLUTION [NOVYY METOD RESHENIYA ZADACH TEPLOPROVODNOSTI DLYA TEL VRASHCHENIYA]
V. I. Makhovikov Dec. 1966 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (USSR), no. 5, 1965 p 151–154
(NASA-TT-F-10499) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The essential feature of the method is that the body of revolution is assumed to be made of a completely nonuniform material, whose thermal conductivity coefficient is a differentiable function of the variables of the cylindrical coordinate system. In the resulting thermal conductivity equation, the temperature is represented in terms of harmonic functions. The boundary value conditions are discussed, and the axisymmetric problem is examined in detail. N.E.N.

N67-13830 Advisory Group for Aerospace Research and Development, Paris (France)
"KNOCK" IN SPARK-IGNITION ENGINES
A. D. Walsh (St. Andrews Univ.) *In its* Low. Temp. Oxidation 1965 p 285–327 refs (See N67-13821 04-06)

The phenomenon of knock in spark ignition engines is explained by a sudden pressure rise in the compressed gas followed by an explosion of "knock". This metallic sound is attributed to shock waves from the explosion impinging upon the cylinder walls and setting them into forced vibration. A careful choice of hydrocarbon fuels and an improved engine design diminishes the occurrence of knock. High speed photographic Schlieren studies proved that knock occurs in the end-gas phase of the engine. Fuels containing tertiary C–H bonds have a high knock resistance in correlation with the step formation of free radicals. Ignition curves and knocking parameters of various hydrocarbon fuels are discussed. G.G.

N67-13831 Advisory Group for Aerospace Research and Development, Paris (France).
THE MODE OF ACTION OF "ANTI-KNOCKS"
A. D. Walsh (St. Andrews Univ.) *In its* Low Temp. Oxidation 1965 p 329–370 refs (See N67-13821 04-06)

The inhibiting effect of lead tetraethyl on engine knock was analyzed and attributed to the formation of lead oxide; it was proposed that lead tetraethyl in oxidation produces a colloidal of solid lead oxide particles that diffuse to the nearest surface under the high pressure conditions of an engine end-gas in very short time. Additions of mono carboxylic acids and their derivatives increase the response of certain fuels to lead tetraethyl in engines of high compression ratio and are known as anti-knock extenders. Aromatic compounds functioning as anti-knocks are mostly limited to compounds that contain only one benzene ring. G.G.

N67-13990# California Univ., Livermore. Lawrence Radiation Lab.
TRUMP: A COMPUTER PROGRAM FOR TRANSIENT AND STEADY-STATE TEMPERATURE DISTRIBUTIONS IN MULTIDIMENSIONAL SYSTEMS
Arthur L. Edwards 24 Feb. 1966 151 p
(Contract W-7405-ENG-48)
(UCRL-14754) CFSTI: HC $5.00/MF $1.00

The TRUMP computer program was developed to solve problems involving transient and steady state temperature distributions in multidimensional systems with arbitrary geometric configurations, initial conditions, boundary conditions, and physical properties. The mathematical method uses a unique combination of forward and backward difference equations to achieve fast, efficient, and accurate solutions. The program is written in separate versions for the IBM-7094, CDC-3600, and CDC-6600. Problems include heat transfer by conduction, free and forced convection, surface radiation, and mass flow. Heat may be produced or absorbed by internal heat sources and sinks, phase changes, and chemical reaction. The properties controlling these effects may be tabulated functions of time or temperature. Input data are organized to be as simple and clear as possible, providing maximum compactness, flexibility, and ease of modification. Optional forms of output include temperature distributions, complete heat balance information, values of variable properties, and a breakdown of the various modes of heat transfer and production at specified time intervals. Graphical output includes plots of temperature vs position at specified time intervals, temperature vs time as specified positions, and position vs time at specified temperatures. Accuracy is determined by the degree to which the system is subdivided into nodes, or volume elements, and by a specified maximum allowable temperature change per time increment. Criteria for ending a problem include exceeding specified time and temperature limits, accomplishment of steady state, and exceeding specified limits on the number of time increments and machine time. Author

N67-14018# Atomic Energy Establishment, Winfrith (England). Control and Instrumentation Div.
A.G.R. STEAM DRUM EXPERIMENT
G. B. Collins 1966 38 p refs
(AEEW-M-631) HMSO: 5s 6d

Steady state and transient measurements made on a forced recirculation boiler steam drum are described, and conclusions are drawn concerning the steady state water subcooling and the dynamic behavior of the water and steam phases during transients. Attempts at parameter identification using a linearized model set up on an analog computer are described, and it is concluded that an asymmetric model is required to adequately describe both increasing and decreasing pressure effects. Further dynamic experiments are suggested using more refined measurement techniques. Author (NSA)

N67-14040# Oak Ridge National Lab., Tenn.
A COMPUTER PROGRAM TO CALCULATE HIGH-TEMPERATURE THERMODYNAMIC FUNCTIONS
T. G. Godfrey and J. M. Leitnaker Sep. 1966 37 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1599) CFSTI: HC $2.00/MF $0.50

A computer program, PLOTHEAT, was written which uses the method of least squares to fit high temperature enthalpy data to one or several selected functions. From the generated equation the heat capacity, C_p^0, the enthalpy, $H_T^0-H_{298}^0$, the entropy, S_T^0, and the free energy function, $(F_T^0-H_{298}^0)/T$, are calculated and tabulated at 100° increments. (The last two quantities assume a knowledge of the entropy at 298.15° K, S_{298}^0.) A subroutine package can be used with the program to plot the computed equation together with the input data using different symbols for each set of data. Author (NSA)

N67-14054# Aerojet-General Nucleonics, San Ramon, Calif.
ALKALI METALS EVALUATION PROGRAM Quarterly Progress Report, Apr. 1–Jun. 30, 1966
P. Y. Achener Aug. 1966 15 p refs
(Contract AT(04-3)-368)
(AGN-8198) CFSTI: HC $1.00/MF $0.50

Work toward obtaining pressure–volume–temperature relations in Cs is briefly described. Apparatus for measurement of the thermal conductivity if Cs and Rb vapors at 1000 to 2000°F is described along with apparatus for Cs vapor viscosity and specific heat at 2000°F. Research on latent heat of vaporization of Na, vapor pressure of Li, surface properties of liquid Na and Li, viscosities of liquid Li and Na, and specific heats of liquid Li and Na is briefly summarized. Topical reports are being prepared on most of these tasks. No data are included. NSA

N67-14089# Iowa State Univ. of Science and Technology, Ames.
THE HEAT CAPACITY OF SOLID HE^3.
Howard Harshaw Sample (Ph.D. Thesis) Jul. 1966 139 p refs
(Contract W-7405-ENG-82)
(IS-T-84) CFSTI: HC $4.00/MF $1.00

Specific heat measurements were made from 0.2°K to the melting line for solid ^{3}He at nine densities and for solid ^{4}He at one density. The results, which cover molar volumes from 23.80 cm^3 to 11.42 cm^3, everywhere were accurate to better than 1% in an equivalent θ_D. The relatively high precision of these experiments and their wide temperature range enabled a determination of the thermal equations of state of both hcp and bcc solid ^{3}He quite unambiguously. The $\theta_D(V)$ relationship which was obtained for hcp ^{3}He gave values of γ which varied from 2.0 at 11.42 cm^3/mole to 2.8 at 19.05 cm^3/mole. For hcp ^{4}He, the value of $\theta_{04}(V)$ and previous data can be obtained from the simple relationship $\theta_{04}(V)=\theta_{03}(V)/1.18$. The constant in this relationship was quite close to the Debye value of 1.154. In all other aspects, hcp ^{3}He and hcp ^{4}He appeared to behave quite like the heavier more classical inert gas solids argon and krypton, with a Grüneisen γ which increased slowly with temperature. The results for bcc ^{3}He indicated that the specific heat contains a large, apparently exponential anomalous contribution which superimposed on a Debye-like behavior as reported previously. Low-temperature anomalies (smaller than but resembling the linear anomalies in previous work) were found in all the data, and are believed to be due to unknown apparatus problems. Author (NSA)

N67-14090# Oak Ridge National Lab., Tenn.
TEMPERATURES IN THE CLADDING UNDER THE SPACERS OF THE BONUS SUPERHEATER ASSEMBLIES
J. P. Sanders 22 Apr. 1966 14 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1452) CFSTI: HC $1.00/MF $0.50

The temperature distribution under the spacers presently used in the BONUS superheater assemblies was calculated with the heating program. A two-dimensional model in cylindrical coordinates (R,θ) was used for a 60° symmetrical segment. The results indicate that if a braze width at the point of contact of at least 40 mils can be obtained, the maximum temperature in the cladding will be less than 1200°F. Author (NSA)

N67-14187# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique
THERMODYNAMIC INTRODUCTION TO IRREVERSIBLE PHENOMENA [INTRODUCTION THERMODYNAMIQUE AUX PHENOMENES IRREVERSIBLES]
Joseph Kestin and Michel Giat Oct. 1966 214 p refs In FRENCH
(Rept.-66-7; Publ.-277) CFSTI: HC $6.00/MF $1.25

The relationship between classical thermodynamics, statistical thermodynamics and the irreversible phenomena in a continuous flow system is established. The classical thermodynamics are defined in detail under consideration of the state of equilibrium and emphasis is made on real, reversible, and quasi statically irreversible transformations. Principles applied to uniform continuous and open systems and to the variable mass system are discussed. ESRO

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N67-13368# Atomic Energy Commission, Washington, D. C. Div. of Industrial Participation.
RADIATION AND ITS COMMERCIAL FUTURE
Ernest B. Trammel *In* Oak Ridge Natl. Lab. Proc. of Inform. Meeting on Irradiated Wood–Plastic Mater. Held at Hilton Hotel, Chicago, Ill. Apr. 1966 p 49–58 (See N67-13361 04-18) CFSTI: $2.00

The responsibilities of the Division of Industrial Participation of the USAEC are described, including the functioning as a focal point for industrial inquiries for civilian applications of nuclear energy. With respect to radioinduced wood–plastic combinations (WPC), three suggestions are presented: WPC should be thought of as new products rather than replacements for existing products; much greater effort in product imagination and in development of new markets needs to be applied; and industry should accept greater responsibility in finding methods of getting these materials into new products and into use. The timely transfer of government-developed nuclear technology into the private sector of our economy is stressed. NSA

N67-13386# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 2, NUMBER 10 Monthly Review of Selected Foreign Scientific and Technical Literature
Oct. 1966 67 p refs

CONTENTS:

1. THE PURSUIT PROBLEM AND THE THEORY OF DIFFERENTIAL GAMES L. Kacinskas p 1–15 refs (See N67-13387 04-19)

2. MEASUREMENT OF THE ANGULAR AND SPECTRAL DISTRIBUTION OF ATMOSPHERIC INFRARED RADIATION BY THE KOSMOS-45 SATELLITE B. Doncov p 6–11 refs (See N67-13388 04-13)

3. CURRENT SOVIET RESEARCH IN THE FIELD OF HEAT-RESISTANT POLYMERS: POLYIMIDES, POLYOXAZOLES, AND POLY-1, 3, 4-OXADIAZOLES B. Nartsissov p 12–20 refs (See N67-13389 04-06)

4. THE INTENSITY OF PENETRATING RADIATION ON THE MOON'S SURFACE p 21–25 refs

5. THE NATURE OF THE LUNAR SURFACE AS DETERMINED FROM GAMMA-RAY SPECTRA OBTAINED BY LUNA 10 p 25–32 refs

6. MEASUREMENTS OF COSMIC-RAY INTENSITY p 33–34 refs

7. SPECTROPHOTOMETRIC MEASUREMENTS OF THE MOON p 35 refs

8. ANALYSIS OF LUNAR PHOTOGRAPHS p 36–37 ref

9. LUNAR ULTRAVIOLET SPECTRUM p 37–38 ref

10. STUDY OF UPPER ATMOSPHERE WIND CIRCULATION BY THE RADAR METHOD p 39–40 refs

11. LASER PHOTOGRAPHY p 40–42 refs

12. PASSIVE Q-SWITCHING OF A RUBY LASER WITH BLEACHABLE PHTHALOCYANINES p 42–45 refs

13. MODELING LARGE CRATERING EXPLOSIONS p 45–40 refs

14. STUDY OF THE THERMAL STABILITY OF SEVERAL NEW POLYBENZIMIDAZOLES WHICH CONTAIN O, P, AND B IN THE CHAINS, AND ALSO OF MIXED POLYAMIDO- AND POLYESTEROBENZIMIDAZOLES BY DIFFERENTIAL THERMAL ANALYSIS p 50–53 refs

15. CONFERENCE ON LOW-TEMPERATURE PHYSICS p 54–56 refs

N67-13396# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF ENGINEERING Selected Articles
21 Jun. 1966 21 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 4, no. 3, 1964 p 446–450, 504–509
(FTD-TT-65-1982; TT-66-62317; AD-639337) CFSTI: HC $1.00/MF $0.50

CONTENTS:

1. NUMERICAL SOLUTION OF CERTAIN PROBLEMS IN THE FLOW OF VISCOUS FLUIDS L. M. Simuni p 1–7 refs (See N67-13397 04-12)

2. ON THE DERIVATION OF A REFINED THEORY OF PLATES M. P. Sheremet'yev and B. L. Peleks p 8–16 refs (See N67-13398 04-32)

N67-13505# National Aeronautics and Space Administration, Washington, D. C.
CURRENT STATUS OF NASA'S NATURAL RESOURCES PROGRAM
Peter C. Badgley *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 547–570 ref (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

The National Aeronautics and Space Administration is supporting research activities in those areas of remote sensing from Earth-orbiting spacecraft which are related to the study of natural and cultural resources. These sensors are believed to possess a number of unique advantages for the discovery, inventory, evaluation, development, and conservation of such resources. Many government agencies, universities, and research institutions are cooperating in this effort. The current status of this program is described. Author

N67-13515# Ohio State Univ., Columbus.
CIVIL ENGINEERING APPLICATIONS OF REMOTE SENSING: THE EDUCATORS' ROLE
Olin W. Mintzer *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 705–708 (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

This discussion deals primarily with the role of education in meeting civil engineering needs in remote sensing. Educational institutions should now develop both a remote sensing curriculum and continuing-education short courses to meet the further demand for new professionals and for increasing the skills of current professionals. A curriculum and short-course program are outlined in this paper. Author

N67-13519# Dartmouth Coll., Hanover, N. H. Dept. of Anthropology.
ANTHROPOLOGY AND REMOTE SENSING
Elmer Harp, Jr. *In* Mich. Univ. Proc. of the 4th Symp. on Remote Sensing of Environment Jun. 1966 p 727–729 refs (See N67-13461 04-14) CFSTI: HC $8.75/MF $3.50

Application of remote sensing to cultural anthropology, especially historic and prehistoric archaeology and socio-cultural anthropology of contemporary man, is investigated. The broad aims of field and laboratory applications are (a) development of economical, yet comprehensive, systems of airborne reconnaissance and survey for use in unexplored regions or other areas that may be remote, costly, and time consuming to explore by conventional methods; and (b) refinement of systems of data interpretation to permit reliable predictions about human social and cultural behavior and also man-environment relationships in past or present time. S.P.

N67-13649# College of Aeronautics, Cranfield (England). Dept. of Flight.
AN ADVANCED COURSE IN AIR TRANSPORT ENGINEERING
David Hyde Aug. 1966 21 p refs
(COA-AERO-172) CFSTI: HC $1.00/MF $0.50

A nine-month postgraduate level course in air transport engineering, emphasizing the maintenance and operation of the aircraft, is described. The syllabus used in the course is included, which is divided into five sections: management, project, systems design and development, operations, and maintenance and overhaul. L.E.W.

N67-13721 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
PHILIPS TECHNICAL REVIEW, VOLUME 27, NO. 3/4
S. Gradstein, D. van Dalen, E. Fischmann, J. M. van Hofweegen, J. W. Miltenburg, ed. et al 1966 49 p refs

CONTENTS:

1. OSMIUM DISPENSER CATHODES P. Zalm and A. J. A. van Stratum p 69–75 refs (See N67-13722 04-09)

2. PHYSIOLOGICAL ASPECTS OF THE LIGHTING OF TUNNEL ENTRANCES D. A. Schreuder p 76–86 refs

3. MICROFRACTOGRAPHY OF THIN FILMS J. M. Nieuwenhuizen and H. B. Haanstra p 87–91 refs (See N67-13723 04-26)

4. AN AUTOMATIC EXPOSURE CONTROL SYSTEM FOR X-RAY DIAGNOSTICS H. Elgstrom and E. Zieler p 92–106 refs

5. GREASE-LUBRICATED SPIRAL GROOVE BEARING FOR A STRAIGHT-THROUGH SHAFT G. Remmers p 107–108 ref (See N67-13724 04-15)

N67-13766# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
NETWORK PLANNING TECHNIQUE. A SURVEY ON THE METHODS OF CPM AND PERT [NETZPLANTECHNIK. EINE UBERSICHT UBER DIE VERFAHREN CPM UND PERT]
A. Papendieck Mar. 1966 46 p refs *In* GERMAN; ENGLISH summary
(DLR-MITT.-66-12) CFSTI: HC $2.00/MF $0.50

During the last years the field of time scheduling for large projects has seen the fast expansion of a new planning method know by many different names. The most frequently used names are Network Planning Technique, Network Analysis, PERT (Program Evaluation and Review Technique), and CPM (Critical Path Method). The number of different names has been estimated to approximately fifty. The methods, however, are only slightly different from each other, the essential principles are inherent to all of them. This report considers the main ideas. Finally, a computer program is described. Author

N67-13880*# California Univ., Los Angeles.
A MANAGEMENT MODEL FOR SELECTING MAJOR SUBCONTRACTORS IN THE AEROSPACE INDUSTRY
Edmund R. Gray (La. State Univ.) Apr. 1966 30 p refs
Sponsored by NASA NASA Res. Paper No. 9
(NASA-CR-80762) CFSTI: HC $2.00/MF $0.50 CSCL 05A

A model of the management decision process for selecting major subcontractors in the aerospace industry is presented. The study is directed specifically toward aerospace executives involved in subcontractor selection decisions. Other interests include an example of a model building technique for approaching complex recurring decision situations. C.T.C.

N67-13912# Marquardt Corp., Van Nuys, Calif.
A DOCUMENTATION—ORIENTED SPECIAL TECHNICAL JOURNAL
Gilbert S. Bahn [1964] 13 p ref
(AD-638751) CFSTI: HC $1.00/MF $0.50

The majority of the papers published to date have been carefully sought out as valuable technical society preprints which were not destined for publication in society journals of broad and huge audiences. Tentative conclusions are drawn as to the availability of such preprinted papers, their characteristics, and the problem of effecting revisions as necessary for publication. Experience in identifying and acquiring review copies of pertinent books is recounted and qualitative statistics are given relative to the extent of reviewing elsewhere. It is concluded that the normal reviewing process is haphazard and far from comprehensive; one seeking to build a library of excellence in his own field is ill-served by the prevailing pattern of technical book reviews. Author

N67-14146# Congress. House. Committee on Government Operations.
GOVERNMENT USE OF SATELLITE COMMUNICATIONS
Washington, GPO, 19 Oct. 1966 110 p 43d Rept. by the Comm. on Govt. Operations, 89th Congr., 2d Sess.
(Rept.-2318)

Results are presented of committee hearings on recent developments in military and civil applications of satellite communications, areas of continuing research and development, interagency relations, and policies covering the procurement of satellite communications from commercial carriers. Consideration is given to satellite communications for defense, proposed rate reductions, and government telecommunications management. Committee recommendations are also included. L.E.W.

N67-14158# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF THE SCIENCE OF PRODUCTION ENGINEERING
I. Onufriyev 15 Dec. 1966 7 p Transl. into ENGLISH from Nauchno-Tekhn. Obshchestva SSSR (Moscow), no. 9, 1966 p 31-34
(JPRS-39132; TT-66-35555) CFSTI: $1.00

Various approaches to the problems incurred by a greatly increased volume of construction work are discussed, and emphasis is placed on the application of automatic computer control. The coordination of workers, design and planning organizations, plant contractors, and transport organizations is considered. An automated construction project system under development is described, and its advantages are outlined. A diagram is included of an information-computer center, which receives data on the progress of the construction, calculates the optimal time for completion, and establishes the critical path and time periods for the work. L.E.W.

N67-14241# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
MAINTAINABILITY, RELIABILITY AND AVAILABILITY
Howard Leroy Barden (M.S. Thesis) Dec. 1965 88 p refs
(AD-627650) CFSTI: HC $3.00/MF $0.75

Following a complete discussion of the problems associated with the definition and quantification of maintainability, it is argued that maintainability is not the equipment parameter to be specified and achieved without regard to other performance parameters. It is proposed in this thesis that inherent availability is the critical parameter to be specified and met by an aircraft weapon system contractor. It is further proposed that a series of availability tests be conducted to reflect a progressively decreasing consumer's risk and allow for increased human experience and engineering improvements. A sequential sampling plan is designed for an exponential or a Weibull distribution of times-between-maintenance and times-to-repair. A hypergeometric sampling plan is presented for use in testing the operational readiness of the test fleet for any given proposed squadron size. Author (TAB)

N67-14260*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
OUTER SPACE AND ARMS CONTROL
Walter C. Clemens, Jr. Oct. 1966 134 p refs
(Grant NsG-496)
(NASA-CR-80853; CSR-TR-66-14) CFSTI: HC $4.00/MF $1.00 CSCL 15C

Attempts to curb ICBM's and decisive factors in present-day United States and Soviet policies are among the topics considered in relation to outer space and the control of weaponry. Factors affecting both the space and arms race are discussed for the 1955-1960 period; and domestic, political, and military factors at the present time are considered. The Soviet-U.S. understanding of 1963 is mentioned, and later challenges to this understanding are covered along with the countervailing restraints. Attention is given to the role of Antarctica in outer space and the outlook for arms control. M.W.R.

N67-14274# International Astronautical Federation, Paris (France). International Inst. of Space Law.
WORLDWIDE BIBLIOGRAPHY FOR THE YEAR 1965 OF SPACE LAW AND RELATED MATTERS
Jun. 1966 65 p refs
(IISL-BIBL.-2) CFSTI: HC $3.00/MF $0.75

A total of 596 refs to books and articles of 246 periodicals, published in 29 countries, are contained in this bibliography. They refer to organs dealing with space law, outline the progress in the conquest of space, the development and general principles of space law and relate to different activities and uses of space (out of the 596 refs mentioned, 172 concern telecommunications). ESRO

N67-14316# Bureau of Mines, Pittsburgh, Pa.
FURTHER STUDIES ON SYMPATHETIC DETONATION
R. W. Van Dolah, F. C. Gibson, and J. N. Murphy 1966 35 p refs
(BM-RI-6903)

Investigations were conducted on sympathetic detonation of ammonium nitrate (AN) and ammonium nitrate-fuel oil (AN-FO) to define the scaling law for safe separation from detonating AN-FO. Both missile- and non-missile-producing AN-FO donors, weighing up to 5400 pounds, were employed with acceptors of the same size. The usual cube-root scaling law was not confirmed; exponents for the relationship $S = f(W^x)$ for AN were 0.51 with non-missile-producing donors and 0.61 for missile-producing donors. For AN-FO an exponent of 0.80 was indicated in the missile-producing case. AN-FO in polyethylene bags appeared somewhat more easily initiated than bulk AN-FO. The efficacy of barricades in protecting AN charges was investigated. Sympathetic detonation distances were reduced from one-third to one-seventh

when sandfilled barricades were employed. The investigation was extended to boxed dynamite with both types of donors. With 1600-pound missile-producing donors and an equivalent weight of dynamite, initiation would be expected in 50 percent of the trials at 167 feet. The corresponding value in the non-missile case was 67 feet.
Author

Collections of NASA Documents

NASA is depositing its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers. Each center, located in one of the organizations listed below, is prepared to furnish the general public such services as personal reference, inter-library loans, photocopy service, and assistance in obtaining retention copies of NASA documents.

California: University of California, Berkeley
Colorado: University of Colorado, Boulder
District of Columbia: Library of Congress
Georgia: Georgia Institute of Technology, Atlanta
Illinois: The John Crerar Library, Chicago
Massachusetts: Massachusetts Institute of Technology, Cambridge
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